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LIFE AND WORKS OF LOUIS FRANCOIS CLEMENT BRÉGUET.

By M. DE JONQUIERES, in *Comptes Rendus.*

THERE are families in which science, art, talent rising sometimes to the height of genius, are transmitted from generation to generation and whose celebrity survives without decline. The Bréguets belong to such a family. The first, Abraham Bréguet, grandfather of him whose life and labours I am about to retrace, was a watchmaker's apprentice at Neuchatel, when at the age of 15 he became the head of his family. A few years afterwards he had, by the force of his will and his talents, completed his neglected education, founded a house in France, to which he had removed in 1762, and established his superiority in the art of constructing chronometers of great precision.

The problem of determining the longitude occupied, with good reason, the attention of maritime nations. The moon was at first depended upon. But the complicated movements of this capricious satellite had then only revealed its easiest secrets; the lunar coordinates could not be foretold with sufficient exactness, and the observations of distances which navigators were accustomed to make, for want of something better, gave most frequently results too wide of the truth. Pending, therefore, the new progress of celestial mechanics and of astronomical tables, the encouragements of Governments and the efforts of artificers were turned to the exact passage of time. In France, Leroy and Berthaud had entered with distinction into the lists, when Bréguet, first their disciple and then their rival, appeared there in his turn. Without loss of time he gained there such a position and established so decisively the supremacy of French chronometry that during the two years when he was obliged to take refuge beyond the Channel to escape the dangers with which political events threatened him on French soil, one of the masters of English watchmaking frankly and openly applied for his assistance and asked for a participation in his secrets.

On his return to Paris he established himself in an ancient house on the Quai de l'Horloge, which has since remained the seat of the family. Here he ended his days in 1823, at the age of 66, having become a member of the Academy of Sciences and of the Board of Longitude.

After him, his son Antoine, as highly endowed, but apparently less persevering in the conduct of business, directed the renowned and prosperous establishment which he had inherited, for 10 years only. One fine day he quitted it, bidding adieu to the world, if not to science. He had not let the business fall off and its reputation had not deciined when his son Louis, who, under his orders had directed the chronometric establishment, was suddenly called to the honour and the responsibility of its management.

If rude trials are necessary to temper characters, Louis Bréguet in this respect lacked nothing to render him equal to his task. His father, imbued with certain philosophic systems then in vogue, had spared him none of the austerities of a training of a Spartan type, hoping, doubtless, to inoculate him with indomitable energy. The result showed that he had not made a false calculation. Close study from four o'clock in the morning to eleven at night under the ever-watchful eye of his father, a profound study of his art and the personal practice of all its details had not merely rendered young Louis an horologist of the first order—the horizon of his ideas had expanded; and on his arrival at power he conceived and realised in his workshops the systematic project of adding to the manufacture of chronometers of precision the construction of other instruments applied in the physical sciences which were then experiencing a mighty development. His grandfather, Abraham, had opened the way by creating entirely the metallic thermometer (known as Breguet's helix), which has remained one of the most sensitive and delicate thermometric instruments. Louis improved it by adding, in 1840, the indication needle invented by his grandfather for astronomical counters, which he subsequently employed for determining, in concert with M. Wertheim, the speed of sound in iron and for realising many other mechanical effects.

This success earned for him, in 1843, the honour of being nominated Member of the Board of Longitude and Corresponding Member of the University of Kasan, and was a fine stimulant for gaining new honours.

His first research in the field of pure theory had for its object electric induction, and was executed in concert with M. Masson, Professor at the Lycée Saint Louis. Their aim was to accumulate without loss the static or tension electricity springing from the reaction of the voltaic current; the two experimentalists were successful. They obtained all the luminous phenomena which had hitherto been produced solely by the glass-plate machine, and in this research, which is now too much overlooked, they established the principles of the induction machine, destined in the skilful hands of Ruhmkorff to take an important place among physical instruments.

Louis Bréguet thus found himself launched into the applications of dynamic electricity, a science born in the 19th century and which, nourished by the genius of Ampère, was developed with giant strides. He applied to it all his ingenious fertility in mechanical combinations and became in France, both by the variety of instruments which issued from his hands and by the generous and disinterested initiation which practical men received in his workshops, one of the leading promoters of this marvellous agency.

In 1845 he devised and constructed the first apparatus for measuring the speed of a projectile at different points of its trajectory. The beautiful instrument since

devised in an analogous order of researches by Marcel Deprez and Sébert should not cause us to forget the first original solution of so important and difficult a problem.

This incursion into military affairs is not the only one which Bréguet tried with success. Twenty-five years later he devised for the service of the engineers an exploder for igniting so-called induction or tension primers at a distance. This device had the important advantage of lightness and portability as compared with other contrivances based upon the same principle. In a small bulk its power is such that it can ignite primers at the distance of Paris to Bordeaux, which is 585 kilometres.

It is known to us, as well as elsewhere, by the name of Bréguet's fist-stroke (*coup de poing Bréguet*) an expressive appellation, since the spark is produced by the abrupt separation of two metallic surfaces previously in contact, whence there results a sudden accumulation of the *vis viva* of the electric current, and what is called the extra current of rupture.

About 1845 a great question was raised among physicists that, namely, between the undulatory and the emissive theories of light. Arago projected the experiments which must settle this question irrevocably, and the mechanical execution of the difficult problem was confided to and successfully solved by Bréguet.

In determining with precision the velocity of the luminous undulations, Bréguet constructed an apparatus which rendered it possible to appreciate the $\frac{1}{240000}$ of a second of time.

When the electric telegraph, theoretically created by Ampère and practically realised by Wheatstone, made its appearance in the world, Bréguet threw himself with ardour into the applications of this astonishing discovery.

Designated in 1845 to take part in the commission which presided over the establishment of the first French electric telegraph from Paris to Rouen, he became its most important member. He applied the principle discovered in 1838 by Steinheil, according to which the second wire of communication was suppressed and the earth left to effect the return of the current; a fruitful principle which economises motive power and the quantity of conductive material, and thus realised an important saving.

The treatise published on this occasion by Bréguet and his services in the Rouen commission earned for him in 1845 the cross of the Legion of Honour.

To him are also due, both in conception and execution, the writing telegraph, the dial telegraph and the movable telegraph. The second of these, adopted by the railway companies for the service of their lines, presents such a simplicity in manipulation and such security in working that a special professional training is almost superfluous.

The contact of Bréguet with the railway service gave him the opportunity of solving numerous interesting problems of security in the movements of trains and the preservation of signals. As one of the most important improvements may be mentioned the lightning guard for preserving the electro-magnets of telegraphs against damage from lightning and securing the officials against danger.

Another application of electricity, due also to Wheatstone, the transmission and distribution of the hour at a distance, became for Bréguet a new subject of research and of signal success. After having installed a first system at Lyon in 1856, to work 72 dials by a current, inverted at each minute, transmitted from a central clock, he improved it in 1857, giving the current the less precarious task of sending periodically the time from ordinary clocks once daily, at noon or midnight. This is no longer, strictly speaking, the transmission of the hour, but its regulation.

Lastly, in 1876, he found himself engaged with the far more arduous problem proposed by Le Verrier, of reproducing to a second the time of the standard clock at the National Observatory by 16 clocks, called horary centres, distributed in different parts of the metropolis. A synchronisation so absolute presented great difficulties in the conditions of absolute certainty which its regular and normal work demands. The fundamental idea of a practical solution had been given by Foucault and ingeniously applied by Vérité of Beauvais. Our colleague Wolf had realised it in the interior of the National Observatory. Bréguet, by carrying it out on a much larger scale for the City of Paris, acquired a further title to the gratitude of savants, of horologists and of the public.

From his workshops, where he was seconded by skilful coadjutors trained under his vigilant direction, there have proceeded :—

The *sphygmograph* with registering cylinder, of our colleague M. Marey, whose imperturbable diagnosis pursues the secrets of fever to the slightest variations of the pulsations.

The *continuous and synchronic regulator* of Yvan Villarceau which, if applied to the equatorial, arrests for the observer the movements of the sun or the stars.

Bertin's *oscillometer*, the indications of which are not disturbed by the sea in its most capricious movements.

Bouguet de la Grye's *seismograph*, an ever wakeful sentinel, whose vigilant watch the most unforeseen and hidden movements of the earth's crust never escape.

The *chronograph* of Captain Fleuriais, who used it at Pekin and elsewhere (along with the fine instruments due to the talent of Brunner), for his varied and important astronomical observations.

But I pass on, for I cannot mention all.

All these researches and services rendered to science marked out Louis Bréguet for a place in the Academy of Sciences. Arago, on the death of Gamby, urged him to offer himself as a candidate so as to take the place which his grandfather had occupied. M. Combes, his opponent, however, carried the day by two votes. An opportunity of entering in the section of Free Academicians presented itself in 1873; Bréguet was about to come forward as a candidate, but withdrew his claims in favour of M. de Lesseps. He was elected in this section the year following.

Four years subsequently he was raised to the grade of officer of the Legion of Honour.

Always ready to bestow his devoted and disinterested co-operation upon savants who requested it, he has left grateful remembrances among his colleagues. Although he had reached an advanced age, he was struck by death in a manner little foreseen by his family and his friends. Three days previously he had taken part, with his accustomed regularity, in one of our annual banquets. But under this appearance of vigour there was hidden, to others though not to himself, the effort which he made to master the incurable pain which was daily exhausting the sources of his life. Struck in his dearest affections by the loss of a daughter, and soon after by that of his nephew, Niaudet-Bréguet, a savant no less beloved than distinguished, there remained to him a son, a former pupil of the Ecole Polytechnique, already known for honourable scientific researches upon whom his most legitimate hopes were built. This successor of his name, the destined upholder of the glory of his house, was in turn carried off in the flower of his age, but already in the maturity of his talents. This catastrophe proved an irreparable blow to the heart of the father.

On October 27th, 1883, suddenly, without the slightest warning, he expired, leaving the most enduring regret to the learned world, and to his widow and his surviving daughter a sorrow upon which respect forbids me to enlarge.

Secondary Generators.—From the results which we publish, obtained by Messrs. Peukert and Zickler on the Zipernowski-Déri transformers, it appears that these apparatus compare favourably with the differently designed induction coils of Gaulard and Gibbs. We do not observe, however, that transformers are meeting with any extended application in electric lighting operations here. There is a good opportunity for their employment in Birkdale if the proposed electric lighting of that place is to be proceeded with.

AN ELECTRICAL "IN" OR "OUT" INDICATOR.

THE accompanying illustrations show a new application of electricity to domestic purposes lately designed and patented by Mr. N. G. Thompson, of Messrs. Thompson, Dowsing & Rew.

The purposes for which it is applicable are entirely distinct from, and have nothing in common with, that of the ordinary bell indicator, its object being to inform any visitor or person who may enter the hall of a building if the friend called on is "in" or "out" without wasting time and strength in mounting the stairs.

It is well known that in most public buildings, and almost all flats, metal indicators set by hand are employed for the above purpose, and the great advantage of this new form of electrical indicator over the old mechanical system is, that the indications cannot be tampered with by mischievous persons entering the hall, and also that the determination of the indication is regulated entirely from the inmates' room.

This latter advantage is well illustrated in cases of families living in flats where it may be desired to indicate "out" at certain periods of the day without th trouble of having to send down stairs to do so.

The general arrangement of the system is shown clearly in fig. 2.

A board, A, is placed in the hall in any convenient place, and on this is fixed a single indicator, B, and any number of pushes, C, C, as shown.

Each push is in electrical communication with the indicator and also with one of a number of switches placed in the different rooms.

Each push, then, has communication with one particular switch and none other, but all the pushes are connected with the indicator.

Assume, then, that Mr. Johnson has a switch in his room as shown at D; by altering this switch to either one of two positions, anybody pressing his push on the board below will observe at the indicator either one of two indications according as Mr. Johnson has set his switch above; and the same will apply to all the other pushes.

The indicator only indicates during the time of pressing the push, and shows a blank when this is released, so that no replacement of any kind is required below.

The system is worked by means of ordinary Leclanché cells, and is excessively simple, and almost impossible to get out of order.

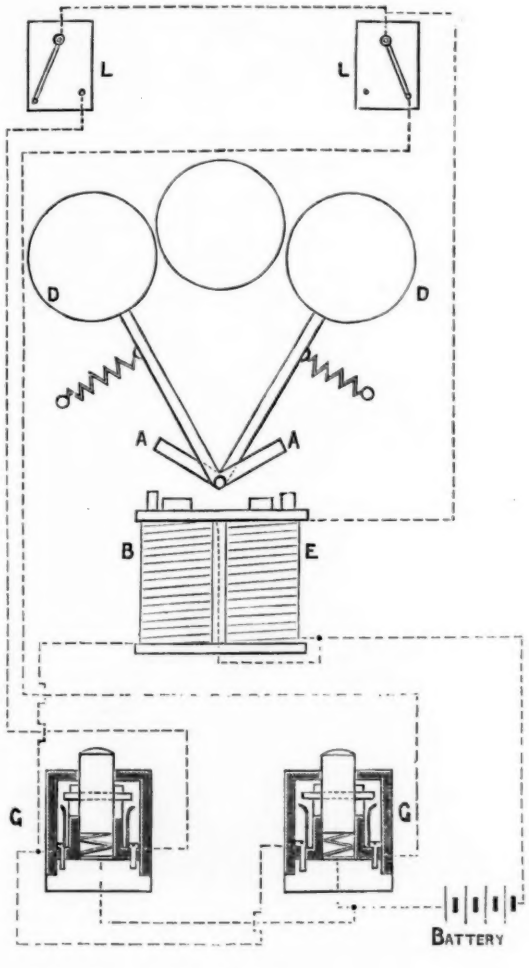


FIG. 1.

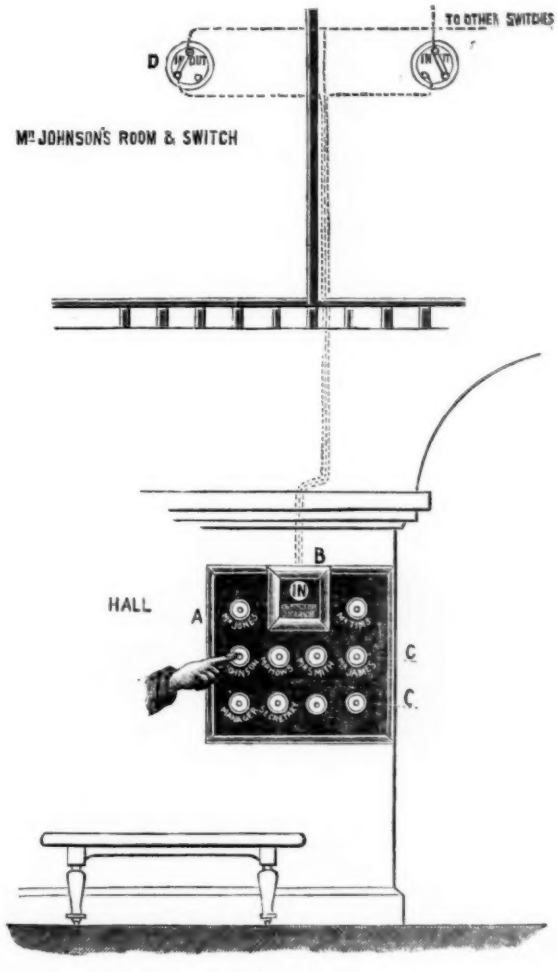


FIG. 2.

The construction of the indicator is shown in fig. 1.

The two magnets, B, E, with their corresponding armatures, A, A, and indicating discs, D, D, may be excited by either one single or two separate circuits; in the first case the current is sent through both magnets, when both discs are required to rise, and through only one magnet when only one disc is required to rise. As one disc obscures the other, it is evident that when the back disc rises only, a different indication will be shown to that when both discs rise.

The question whether only one magnet or both shall be excited is ruled by the position of the switches, L, L, in the rooms above, the pushes, G, G, only acting as contact makers and breakers.

In the second case, where separate circuits are employed to each magnet, only one disc rises at a time.

Another arrangement is to place one magnet on a separate and independent circuit worked by a single cell, the switches and pushes having the same functions as before. Mr. Thompson has also provisionally patented another form of indicator, the position of whose discs is not only determined by the switch above, but is also worked by the action of setting it over.

The indications in this case always show either "in" or "out," and require no manipulation on the caller's part. The interesting feature of this form is that the disc, in performing its action, breaks circuit, but makes contact for another circuit on the open side of the switch which, when again placed over, repeats the action, and thus the battery is only momentarily on whilst the disc is falling over.

We understand that Messrs. Thompson, Dowsing and Rew have fitted up the prior form of indicator at Mansion House Buildings, 4, Queen Victoria Street, E.C., where it can be seen in action, and are now making extensive arrangements for pushing the same into notice through country agents.

THE EFFICIENCY OF TRANSFORMERS.

THE firm Ganz and Company, of Budapest, have handed over to the Electrotechnical Institute, for H. Déri, write W. Peukert and K. Zickler in *Zeitschrift für Electrotechnik*, a transformer (Zipernowski-Déri-Bláthy system) of a more recent construction, with the wish that its capability might be tested; and Dr. A. von Waltenhofen has entrusted us with the independent execution of this investigation.

The method followed and the results obtained form the subject of the following communication.

The transformer has the recent annular shape shown in fig. 2.* The apparatus examined was, according to

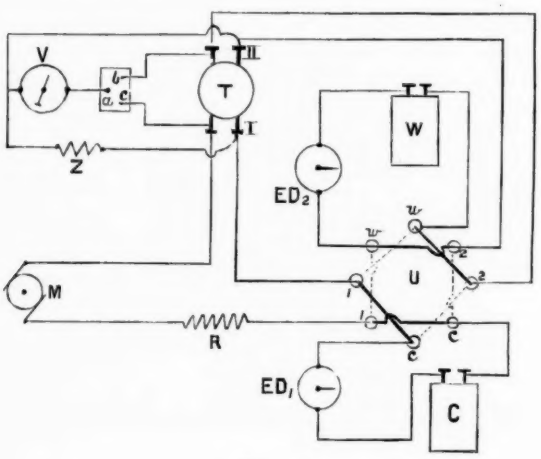


FIG. 1.

the statements, of the form constructed for 1,400 voltampères with a primary tension of 300 volts, and its coefficient of transformation was $\frac{1}{3}$th; 100 was stated as the most suitable number of polar changes per minute. A measurement of resistance gave for the primary coil 0·943 ohm, and for the secondary 0·107 ohm.

The alternating currents were furnished by a Siemens and Halske alternating machine with eight bobbins arranged in series. The exciting machine was a Schuckert flat ring machine (model E L_1). For measuring the strengths of the currents both a Siemens and Halske electro-dynamometer and a calorimeter were used. The latter consisted of a spiral wire of nickel silver coiled double upon a wooden frame. The wire was 0·71 millimetres in diameter, and its resistance at 15° C. was 1·66 ohm. These spirals were placed in a cylindrical vessel of strong sheet copper 16 centimetres wide and 22 centimetres high. The ends of the calorimeter wire were passed, duly insulated, through the cover to two clamps fixed upon it and duly insulated. An aperture in the middle of the lid served for the introduction of a normal thermometer graduated in tenths of a degree. Uniformity of temperature in the calorimeter liquid was secured by means of a suitable agitator. For the liquid we used distilled water, having first convinced ourselves of its suitableness by preliminary experiments.

To prevent loss of heat the calorimeter was surrounded with a double flannel covering. For determining the potential differences at the ends of the primary and secondary coils we used a Cardew's voltmeter, the indications of which had been accurately checked by a previous calibration.

As the degree of efficacy, η, of the transformer is the proportion of the energy given off by it (represented by the product of the strength of the secondary current, i, and the potential, δ, at the ends of the secondary coils) to the energy taken up (given by the product of the strength of the primary current, J, and the potential, Δ, at the ends of the primary coil), the potentials, δ, Δ, and the strengths of the currents, i and J, must be measured.

The accompanying fig. 1 shows the arrangement of the apparatus. From the mercury cups of a commutator, U, specially constructed for this investigation, cable conductors passed to the various apparatus. This commutator was made of a board of hard wood of suitable thickness in which there were eight holes, symmetrically arranged to receive the mercury.

For the sake of complete insulation glass cups were fitted into these holes. Semi-circular hoops of thick insulated copper cable served as connections between the mercury cups.

Pieces of cable in firm connection with the mercury

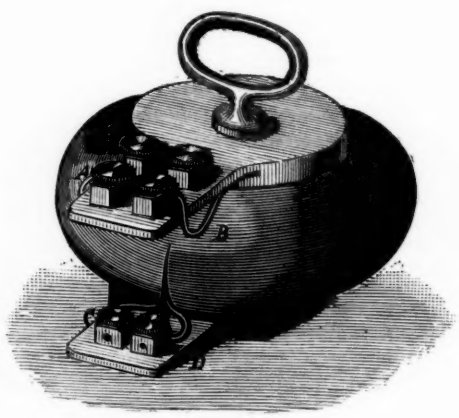


FIG. 2.

cups supported clamps for the reception of the conductors to be applied to the commutator, in accordance with which the marks of the cups of the commutator are selected in the figure. The cups, 1, 1, are connected with the machine, M, and the primary coil, I, of the transformer, T; 2, 2, are connected with its secondary coil, II, whilst at c, c and w, w, are applied the calorimeter, C, or in its place the resistance, W.

In the position of the hoops of the commutator shown in the figure the currents furnished by the machine, M, traverse the primary coil of the transformer, T, arrive through 1 and c at the Siemens electro-dynamometer, ED_1, at the calorimeter, C, and from here by way

* For an exhaustive account of these generators see ELECTRICAL REVIEW for August 1st, 1885.

of c, 1, over the resistance, R, back to the second clamp of the machine. The resistance, R, just mentioned was a Siemens wire sieve rheostat, and served to regulate the potential at the clamps of the machine as we wished to determine the efficacy of the transformer under different conditions. The currents induced in the secondary coil, II, of the transformer passed over 2, w, through the electro-dynamometer, ED_2, from here through the supplemental resistance, W, by way of w, 2, back to the second clamp of the secondary coil. As regards the resistance, W, which was exactly equal to the resistance of the calorimeter wire, it must be remarked that it was prepared from the same sort of wire as the latter and in exactly the same manner, and was also placed in distilled water so that on the transposition about to be described it formed a perfect substitute for the calorimeter.

For the measurement of the potentials at the clamps of the transformer a Cardew's voltmeter was used. The potential conductors in question, as shown in the figure, were so arranged that by means of a three-limbed commutator (a, b, c), the voltmeter, V, could be conveniently affixed to the clamps of the primary and secondary coils of the transformer. Z in the figure shows an additional resistance (1,400 ohms, the Siemens plug-rheostat), which in measuring the primary potential was introduced in front of the voltmeter, as this latter permits direct measurements only up to 125 volts. How in this case the terminal potential in volts is ascertained has been already stated in the *Zeitschrift*.

The calorimeter employed in the investigation had mainly the object of checking the indications of the electro-dynamometers, and therefore both the primary and secondary currents were measured with it. The transposition necessary for this purpose could be conveniently effected (after the machine was disconnected) by transposing the hoops of the transformer. The primary current was first measured in the position shown in the figure with the electro-dynamometer, ED_1, and the calorimeter, and the secondary current with the electro-dynamometer, ED_2. The machine was then disconnected, and the hoops of the commutator being placed in the position shown in figure by the dotted lines, the calorimeter and the electro-dynamometer, ED_1, were introduced into the secondary circuit, the supplemental resistance, W, and the electro-dynamometer, ED_2, into the primary circuit, and the measurement was repeated.

Before turning to the results obtained, we must mention that a close agreement was observed between the indications of the calorimeter and of the electro-dynamometers. The quantity of water of the calorimeter was determined by weight; the specific heat of the copper was taken as 0·095. For calculating the resistance of the calorimeter wire, which had been found = 1·66 ohm at 15° C., the mean between the initial and the final temperature of the calorimeter liquid was taken, and the change of resistance of the nickel silver was taken as 0·046 per cent. for 1° C.

The strength of the current was calculated in the usual manner from the heat taken up by the calorimeter.

In the following table of the results J and Δ denote primary strength of current and primary potential, i and δ have the same signification for the secondary wrapping. The values given for these magnitudes are the means of many experiments conducted in both the manners of introduction above-mentioned, and which gave very concordant results.

Primary current, J.	Primary potential, Δ	Sec. current, i	Sec. potential, δ	Effect taken up, J Δ	Effect given out, $i\,\delta$	Degree of efficiency, $\eta\,\xi$	Polar change per second.
2·71	125·5	12·42	24·0	340·105	298·080	87·6	102
3·00	142·5	14·36	26·4	427·500	379·104	88·6	102
4·37	191·3	20·91	35·6	835·806	743·668	88·9	100
4·83	208·9	23·47	39·5	1008·987	927·065	91·8	109

The primary potential, Δ, contained in the table range from 125·5 to about 209 V, which last is the highest potential obtainable from the alternating-current machine at our disposal without introducing resistances at the clamps of the transformer. At this potential the degree of efficacy of the transformer was found in round numbers to be 92 per cent. The results obtained at lower potentials and here introduced show an increase of the degree of efficiency with the primary potential, whence the conclusion appears admissible that at the normal demand made upon the transformer (300 volts primary tension) for which it is constructed, the degree of efficiency would probably somewhat exceed the maximum value found by us. Hence the result of our examination agrees with the statements (95·2 per cent.) made by Herr Déri in his discourse "Alternating Currents and their part in Electrotechnics."*

In addition to the above experiments, repeated measurements with the transformer have been undertaken in practical work with the students of the Electrotechnical Institute, and they confirm the above results.

REVIEW.

Electric Transmission of Energy. By GISBERT KAPP, A.M.I.C.E. London: Whittaker & Co.

(THIRD NOTICE.)

The seventh chapter deals with "the line." Mr. Kapp gives us seven points which have to be taken into account when determining the most economical size of a conductor for the electric transmission of energy, viz. :—1. The rate of interest to be charged on capital outlay. 2. The cost of one horse-power hour at the terminals of the generator. 3. The number of hours per annum that the energy is required. 4. The cost of unit weight of the conducting material. 5. The cost of insulation. 6. The cost of supports if an overhead line, or troughs if an underground line. 7. The cost of labour in laying. Commenting upon "Sir William Thomson's law" concerning the economy of metal conductors of electricity, the author says, justly, that this law only applies to cases where the capital outlay is strictly proportional to the weight of metal contained in the conductor. "In practice this is, however, seldom correct. If we have an underground cable, the cost of digging the trench and filling in again will be the same, whether the cross-sectional area of the cable be half a square inch or one square inch or more; and other items, such as insulating material, are, if not quite independent of the area, at least dependent in a lesser degree than the formulæ. In an overhead line we may vary the thickness of the wire within fairly wide limits without having to alter the number of supports, and thus there is here also a certain portion of the capital outlay which does not depend on the area of the conductor."

Mr. Kapp thereupon modifies the original algebraic expression, and brings in factors which represent that part of the capital outlay which is constant and independent of the area of the conductor. Sir William Thomson's law refers to the amount of metal required to carry a given current with a maximum economy, without regard to those formidable items—insulation, support, and labour of laying conductors. Professors Ayrton and Perry, in an interesting paper, "Economy in Electrical Conductors," supplemented by an article, "Minimum Waste and Maximum Economy" (*vide* ELECTRICAL REVIEW, April 9th, 1886), have given us a modification of Sir W. Thomson's law, wherein they show that although the said law "is perfectly correct mathematically, it cannot generally be used to determine the conditions of maximum economy, because some electrical condition, either in addition to the strength of the current, or in place of the strength of the current, is given us." Sir William takes the difference of potential at the terminals of the generat-

* See ELECTRICAL REVIEW for February 12th and 19th, 1886.

ing dynamo. Professors Ayrton and Perry choose to measure the same at distant points. Professor George Forbes's excellent table, referring to the sectional area of conductors required to carry a current of 1,000 ampères, if the annual cost of one electrical horse-power varies from £5 to £20, as well as that on the carrying capacity and heating of wires, give this chapter an enhanced value.

In Chapter VIII. we find descriptions and numerous illustrations of details relating to the construction of lines or circuits for electric distribution; the relative merit of a wire for aerial lines is expressed by the product of its breaking strain and conductivity, and Mr. Kapp finds that the compound wire is 30 per cent. better than copper wire, but that in practice this apparent gain will be counterbalanced by the increased cost of manufacture. From estimates given on page 204 we learn again that silicium bronze wire, although an expensive material, shows a very considerable saving over that of galvanised iron wire for lines which are carried on poles.

"If we would judge fairly the merits of a new invention, we should not only look upon it by itself, but compare it with all that has gone before and might be superseded by it." With these words the author introduces the ninth chapter; then he goes on quoting Mr. Walker's expression in a contemporary, saying: "How easily and how quickly, and with little occasion for repairs, can two cables be laid in almost any position for mines, ironworks, docks, factories, as compared with shafting, ropes, steam pipes, compressed air. I have every confidence that the day will come when shafting and belts in factories will be looked upon as a barbarism, and people will wonder however they endured it so long." Mr. Kapp does not quite believe in this, he is evidently a disciple of the philosopher Zeno, in a word, he is a stoic; the reply to the above quotation proves it. He says on page 221: "Whether electricity is ultimately destined to supersede shafting, pulleys and other gear now commonly used for transmitting energy over short distances, is a question which only enthusiasts, or those imperfectly acquainted with the technical part of the subject, can be bold enough to answer." Throughout the book we find the same coolness, a constant adherence to established facts, and the endeavour to preserve a philosophical indifference to prophetic allusions.

The comparison between the four important systems of transmission for long distances, viz., the electric, the hydraulic, the pneumatic and the wire rope transmission, is not so well rendered as it might be. Herr Beringer's estimates of the cost of a horse-power hour, and the relative capital outlay, have been taken as a basis for the arguments which are summed up as follows:—"1. It pays to transmit cheap water power; by wire rope if the distance is less than a mile, and electrically if the distance is a mile, or more. This applies to all powers. 2. It pays to transmit cheap steam power if the amount of energy required at the receiving station does not exceed 10 horse-power. If the distance is less than a mile, use wire rope transmission; for distances of one mile and upwards, up to two or three miles, use electric transmission. Beyond this limit a small local steam or gas engine is preferable."

Wire rope transmission has not found much favour in this country in spite of its economy. There are certain inconveniences attending it, which in thickly populated districts are not easily overcome; it is difficult to go round corners with it. With regard to hydraulic and pneumatic transmission, these are not considered in the above summary, but the views expressed in the text tends to show that electricity, with very few exceptions, has a decided advantage over these systems.

General comparisons are, however, often misleading; they serve very well for an introduction to the subject, and we think that a few particular examples ought to have been given, by way of illustration. One case, for instance, where water power is available within a given distance, another in the vicinity of a coal mine, but where small powers have to be distributed over a considerable area. Both examples to be as nearly as possible within the reach of the four systems.

Chapter X. gives a classification of the best known dynamo machines and electro-motors, together with descriptions and performances of different types.

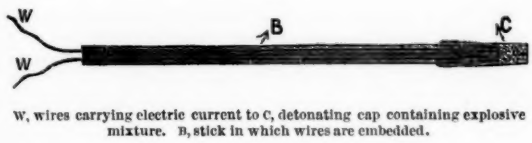
Concerning Chapter XI., Mr. Kapp considers within the narrow limits of 28 pages, a variety of applications for electric motors, such as ploughing, electric cranes, pumping, electric railways, electric tramways and telpherage. The author does not profess to go deeply into the subject of electric locomotion, knowing well that in order to do justice to it, he would have to write a volume at least equal in size to that devoted to "electric transmission of energy." We trust that such a separate volume may be forthcoming. There is ample material to select from, and Messrs. Whittaker need not be at a loss at finding a suitable author.

M. Marcel Deprez's experiments, of which we have heard, read and written, so much that we can barely find words now, make up the concluding chapter of a book which we have perused with profit and with pleasure. We repeat that Mr. Kapp's treatise is one of the most useful and one of the most reliable, as far as electrical literature goes, and we hope to see it run through several editions.

SHOT FIRING IN MINES BY ELECTRICITY.

THE Accidents in Mines Commission some little time since issued a voluminous report, the result of very exhaustive inquiries and experiments made by them with a view to the frightful explosions periodically occurring in our coal mines being mitigated. They laid great stress upon the danger caused by the naked flame which must be present at the explosion of a shot, and which, coming into contact with any explosive gas that may be at hand would be sure to ignite it. They recommended the use of certain explosives in lieu of gunpowder which, fired under stated conditions, can give off no flame. To explode these shots they name electricity in the following emphatic terms:—"Electrical exploding appliances present very important advantages from the point of view of safety over any kind of fuze which has to be ignited by the application of flame to its exposed extremity, as the firing of shots by their means is not only accomplished out of contact with air, but is also under most complete control up to the moment of firing. Their simplicity and certainty of action have been much increased of late years, while their cost has been greatly reduced, and but little instruction is now needed to ensure their efficient employment by persons of average intelligence."

We are interested, therefore, in noting any advances in this direction. The electric fuze has now been so much improved as to make it both cheap and simple. It can be supplied at very little greater cost than ordinary firing fuze. The handiest form we have seen it made in is the miner's stick fuze manufactured by the Electric Blasting Apparatus Company, Cinderford, Gloucestershire, of which we give a sketch.



W, wires carrying electric current to C, detonating cap containing explosive mixture. B, stick in which wires are embedded.

These are made of any length according to the depth of the shot holes, one being placed in the centre of each charge of explosive. The two wires which connect the fuze to the firing battery are protected by being embedded in the stick—no entanglement or abrasion of the wires while charging the hole can thus take place. The sticks can be carried by the miner under his arm without difficulty. Magnetic exploders

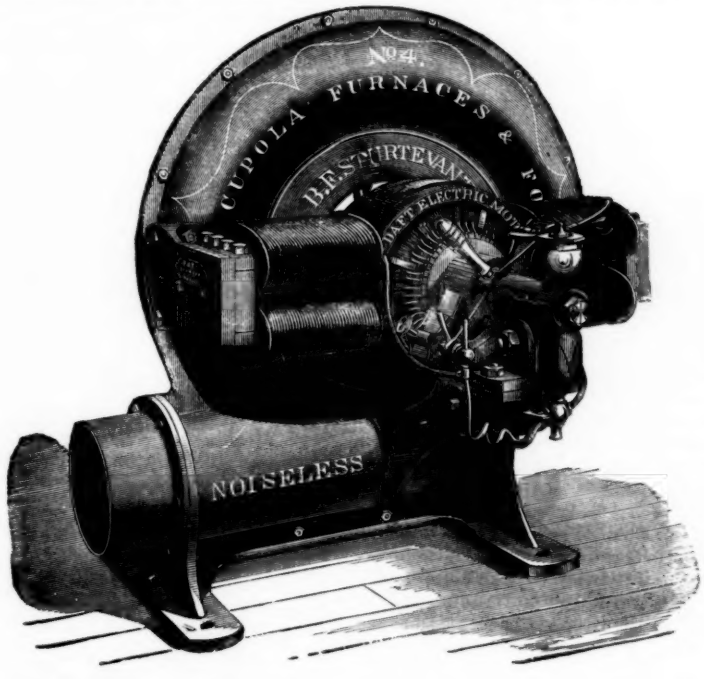
or batteries have generally been used for firing shots by electricity. When a number of shots have to be fired at intermittent times great distances apart in the mine it necessitates the employment of a great number of these machines. The exploders generally in use are weighty, expensive and delicate, unsuitable for the hands of the miner, and will not with certainty generate enough electricity to explode any great number of shots simultaneously. We notice that a patent has just been granted to Mr. Frank Brain, a mining engineer, for "a novel method of shot firing and blasting in mines by the agency of electricity," which will, we apprehend, obviate this difficulty, and make shot firing by electricity a very simple matter. A main cable is laid down from the surface into the workings of the mine. This has constantly passing through it a current of electricity supplied by a dynamo machine. Branch leads connect the various working places with the main cable, and a special non-sparkless switch is so arranged that at any time the fireman in charge of the shot firing may, by unlocking a small box containing the switch, fire any number of shots connected to these branch leads. Another application of this system is to fire every shot simultaneously from the surface after all workmen have left the mine, thus making it impossible for loss of life to be caused by shot firing. We commend this ingenious proposal to the consideration of mine managers.

JUDGES AND PATENTS.

PROF. SILVANUS THOMPSON has made the following interesting and forcible contribution to the discussion relating to patent litigation (see last week's REVIEW) in a letter to the *Times* :—

"The very wide experience of Mr. Imray, past President of the Institute of Patent Agents, as a professional expert in patent litigation gives unusual value to the views which he has put forth in the reply which he gave in your columns of July 7th. I have, indeed, in one or two cases been subpœnaed as a scientific witness ; had I not been, I should probably not have seen so much of the evil practice to which I have drawn attention, and which has of late been the subject of much unpleasant comment in the technical journals. But my experience is nothing as compared with that of Mr. Imray ; hence I hail as of peculiar value his contribution to the question of the judicial warping of patents.

"Mr. Imray, in his capacity as a professional expert, now lays down the whole duty of the judge in a manner which I believe is quite borne out by the actual recent practice of the Courts. He is referring specifically to a certain patent taken out by the American electrician Edison and he says :—'In such a case Judges *who know their duty*'—the italics are mine—'do not tie down the invention to the precise details given by the inventor ; they look for the principle on which the invention is based.' That would, I take it, be entirely fair if the inventor had discovered, stated, and claimed the principle on which his invention is based. But, unfortunately for Mr. Imray and for the example in point, the inventor in this case has particularly and in terms thrown aside any claim to the general principle. The claiming clause of the Edison specification is preceded by an emphatic statement that the inventor observes in conclusion that he does not claim the general principle, which, in fact, was old and publicly known at the date of his patent. Mr. Imray's statement therefore amounts to this—that a judge who knows his duty (the phrase is a useful one) will give the inventor that which the inventor has expressly disclaimed. Mr. Imray's statement clearly confirms my contention that there exists a judicial practice of patent warping—a practice which is essentially unjust. But Mr. Imray's letter is still more informing as to the part played by experts in misleading judges. Though he is angry with me for saying that such things are done, he is so kind as to



POWER FRO CENTRAL STATIONS.

THE success that has attended the electrical transmission of power, the *Mechanical World* thinks, is very encouraging, and would seem to lead us to expect before long a large increase in the number of central stations from which power may be had.

The fig. shows a Daft motor attached to a Sturtevant blower, the two together forming practically one machine. Here the high speed of the motor shows its value, but it has also a regulating switch, which allows the speed to be changed to any desired extent. Thus, in the blower shown, which requires 2 horse-power, three speeds are obtained—of 800, 2,000, and 2,700 revolutions per minute. This is accomplished by changing the resistance of the field, thus doing away with outside resistances and entailing no loss of work due to their employment. For ventilating purposes in theatres, foundries, and other places where noxious gases or vapours rapidly accumulate, such a blower with its motor placed in the roof would go far toward remedying the inconvenience experienced from the vitiation and contamination of the atmosphere.

furnish me with a typical example. He declares that Edison's invention was not a mere improvement in constructive details or in combinations. Now there is only one claim in the Edison specification, and it reads thus: 'but I claim as my invention, in an instrument for transmitting electric impulses by sound, *the combination* with a diaphragm or tympan of electric tension regulators, &c.' Mr. Edison, inventor, claims as his invention a combination; Mr. Imray, expert, declares that it did not consist in combinations. Which is right? Is this the kind of evidence that judges are accustomed to get from experts? Will Mr. Imray swear in court that Edison's sole claim does not consist in a combination?

"Lastly, Mr. Imray says that Edison's telephone patent is a 'new invention' of a 'fundamental' character, an 'altogether novel departure,' and that it is *in such a case* that judges who know their duty do not tie down the invention to the precise details given by the inventor. It is not self-evident why a judge should be so unjust as to give to a patentee a monopoly over more than his patent entitles him to, even if he were the discoverer of an absolutely new departure in invention. But, in this instance, Mr. Imray knows as well as I do that Edison's own specification states that the patent is for 'improvements'—improvements on the telephones that had gone before; that the patentee was given by his employers a description of the earlier instruments as a basis on which to improve, and moreover that the 'new invention' was of so very 'fundamental' a character that it was of no practical use until after the subsequent invention by Hughes of the microphone. Yet Mr. Imray urges this 'fundamental character' as the reason why judges should not tie down the inventor to the precise thing that he has invented! In other words, let an eminent expert bamboozle the judges into thinking that a mere improvement is a great and new invention; let him swear as an expert that a mere claim to a specific combination is a claim to a general principle; then the judges 'who know their duty,' as laid down in the ethics of the past President of the Institute of Patent Agents, will do it. I take Mr. Imray's letter as furnishing a singularly apt illustration of the way in which judges 'are misled by counsel and expert witnesses to such an extent that they quite misunderstand patent specifications, and consequently give unjust judgments.' That is precisely what occurred in the recent case of the United Telephone Company *versus* Bassano, at least as regards those issues of Mr. Justice North's judgment which were not confirmed by the Court of Appeal, and also, if the *Times* report of the proceedings of the Court of Appeal be correct, in the stretching by Lord Justice Cotton of Edison's specification so as to include in it things that were invented a year afterwards by Hughes. And there are various other recent cases—notably the gas engine decisions—in which a similar judicial warping of patents has occurred."

CORRECTION FOR RESISTANCE COILS.

OWING to the wide range of the variation of temperature in cable huts, or testing stations, both above and below the temperature at which the resistance coils are tested and adjusted during manufacture, some ready means of correcting the errors in observations, arising from this source, is evidently necessary.

As an example of the possible error in the case of coils wound with German silver and adjusted at a temperature of 65° F.; if the electrical measurements are made in a hut, or station, at a temperature of 30° F. higher or lower than the said 65° F., the true calculated temperature of the cable would be about four degrees higher or lower than the temperature as calculated from the actual measurements.

To avoid the usual lengthy calculation, tables have been drawn up for the correction of coils wound with German silver, platinum-iridium, and silver-platinum, these being the alloys generally used in the manufacture of resistance coils. The "Silvertown reduction tables" give the correction for every degree and every half-degree between 110° and 35° F., taking 65° F. as a base, this being the temperature at which the resistance coils are adjusted at the Silvertown works. After consulting the best authorities the following coefficients have been adopted for the formation of the tables:

German Silver.

Variation per cent. per 1° F. = 0·025

Coefficient for 1° below 65° F. = 1·00025 = log. 0·0001083
" " 1° above 65° F. = 0·99975 = log. $\bar{1}$·9998917

Platinum-Iridium.

Variation per cent. per 1° F. = 0·034

Coefficient for 1° below 65° F. = 1·00034 = log. 0·0001472
" " 1° above 65° F. = 0·99966 = log. $\bar{1}$·9998528

Silver-Platinum.

Variation per cent. per 1° F. = 0·017

Coefficient for 1° below 65° F. = 1·00017 = log. 0·0000759
" " 1° above 65° F. = 0·999825 = log. $\bar{1}$·9999241

THE SILVERTOWN REDUCTION TABLE.

Silver-Platinum.

Variation per cent. per 1° F. = 0·017.
Coeff. for 1° below 65° F. = 1·00017 = log. 0·0000759
" 1° above 65° F. = 0·999825 = log. $\bar{1}$·9999241

Temp. Fah.	Logarithm.	Temp. Fah.	Logarithm.	Temp. Fah.	Logarithm.
110°	$\bar{1}$·9965845	84·5	$\bar{1}$·9985199	59·5	0·0004174
109·5	·9966224	84	·9985579	59	·0004554
109	·9966604	83·5	·9985958	58·5	·0004933
108·5	·9966983	83	·9986338	58	·0005313
108	·9967363	82·5	·9986717	57·5	·0005692
107·5	·9967742	82	·9987097	57	·0006072
107	·9968122	81·5	·9987476	56·5	·0006451
106·5	·9968501	81	·9987856	56	·0006831
106	·9968881	80·5	·9988235	55·5	·0007210
105·5	·9969260	80	·9988615	55	·0007590
105	·9969640	79·5	·9988994	54·5	·0007969
104·5	·9970019	79	·9989374	54	·0008349
104	·9970399	78·5	·9989753	53·5	·0008728
103·5	·9970778	78	·9990133	53	·0009108
103	·9971158	77·5	·9990512	52·5	·0009487
102·5	·9971537	77	·9990892	52	·0009867
102	·9971917	76·5	·9991271	51·5	·0010246
101·5	·9972296	76	·9991651	51	·0010626
101	·9972676	75·5	·9992030	50·5	·0011005
100·5	·9973055	75	·9992410	50	·0011385
100	·9973435	74·5	·9992789	49·5	·0011764
99·5	·9973814	74	·9993169	49	·0012144
99	·9974194	73·5	·9993548	48·5	·0012523
98·5	·9974573	73	·9993928	48	·0012903
98	·9974953	72·5	·9994307	47·5	·0013282
97·5	·9975332	72	·9994687	47	·0013662
97	·9975712	71·5	·9995066	46·5	·0014041
96·5	·9976091	71	·9995446	46	·0014421
96	·9976471	70·5	·9995825	45·5	·0014800
95·5	·9976850	70	·9996205	45	·0015180
95	·9977230	69·5	·9996584	44·5	·0015559
94·5	·9977609	69	·9996964	44	·0015939
94	·9977989	68·5	·9997343	43·5	·0016318
93·5	·9978368	68	·9997723	43	·0016698
93	·9978748	67·5	·9998102	42·5	·0017077
92·5	·9979127	67	·9998482	42	·0017457
92	·9979507	66·5	·9998861	41·5	·0017836
91·5	·9979886	66	·9999241	41	·0018216
91	·9980266	65·5	·9999620	40·5	·0018595
90·5	·9980645	65	0·0000000	40	·0018975
90	·9981025	64·5	·0000379	39·5	·0019354
89·5	·9981404	64	·0000759	39	·0019734
89	·9981784	63·5	·0001138	38·5	·0020113
88·5	·9982163	63	·0001518	38	·0020493
88	·9982543	62·5	·0001897	37·5	·0020872
87·5	·9982922	62	·0002277	37	·0021252
87	·9983302	61·5	·0002656	36·5	·0021631
86·5	·9983681	61	·0003036	36	·0022011
86	·9984061	60·5	·0003415	35·5	·0022390
85·5	·9984440	60	·0003795	35	·0022770
85	·9984820				

THE SILVERTOWN REDUCTION TABLE.

Platinum-Iridium.

Variation per cent. per 1° F. = 0·034.

Coeff. for 1° below 65° F. = 1·00034 = log. 0·0001472.
„ „ 1° below 65° F. = 0·99966 = log. $\bar{1}$·9998528.

Temp. Fahr.	Log.	Temp. Fahr.	Log.	Temp. Fahr.	Log.
110·0	$\bar{1}$·9933760	84·5	$\bar{1}$·9971296	59·5	0·0008096
109·5	·9934496	84·0	·9972032	59·0	·0008832
109·0	·9935232	83·5	·9972768	58·5	·0009568
108·5	·9935968	83·0	·9973504	58·0	·0010304
108·0	·9936704	82·5	·9974240	57·5	·0011040
107·5	·9937440	82·0	·9974976	57·0	·0011776
107·0	·9938176	81·5	·9975712	56·5	·0012512
106·5	·9938912	81·0	·9976448	56·0	·0013248
106·0	·9939648	80·5	·9977184	55·5	·0013984
105·5	·9940384	80·0	·9977920	55·0	·0014720
105·0	·9941120	79·5	·9978656	54·5	·0015456
104·5	·9941856	79·0	·9979392	54·0	·0016192
104·0	·9942592	78·5	·9980128	53·5	·0016928
103·5	·9943328	78·0	·9980864	53·0	·0017664
103·0	·9944064	77·5	·9981600	52·5	·0018400
102·5	·9944800	77·0	·9982336	52·0	·0019136
102·0	·9945536	76·5	·9983072	51·5	·0019872
101·5	·9946272	76·0	·9983808	51·0	·0020608
101·0	·9947008	75·5	·9984544	50·5	·0021344
100·5	·9947744	75·0	·9985280	50·0	·0022080
100·0	·9948480	74·5	·9986016	49·5	·0022816
99·5	·9949216	74·0	·9986752	49·0	·0023552
99·0	·9949952	73·5	·9987488	48·5	·0024288
98·5	·9950688	73·0	·9988224	48·0	·0025024
98·0	·9951424	72·5	·9988960	47·5	·0025760
97·5	·9952160	72·0	·9989696	47·0	·0026496
97·0	·9952896	71·5	·9990432	46·5	·0027232
96·5	·9953632	71·0	·9991168	46·0	·0027968
96·0	·9954368	70·5	·9991904	45·5	·0028704
95·5	·9955104	70·0	·9992640	45·0	·0029440
95·0	·9955840	69·5	·9993376	44·5	·0030176
94·5	·9956576	69·0	·9994112	44·0	·0030912
94·0	·9957312	68·5	·9994848	43·5	·0031648
93·5	·9958048	68·0	·9995584	43·0	·0032384
93·0	·9958784	67·5	·9996320	42·5	·0033120
92·5	·9959520	67·0	·9997056	42·0	·0033856
92·0	·9960256	66·5	·9997792	41·5	·0034592
91·5	·9960992	66·0	·9998528	41·0	·0035328
91·0	·9961728	65·5	·9999264	40·5	·0036064
90·5	·9962464	65·0	0·0000000	40·0	·0036800
90·0	·9963200	64·5	·0000736	39·5	·0037536
89·5	·9963936	64·0	·0001472	39·0	·0038272
89·0	·9964672	63·5	·0002208	38·5	·0039008
88·5	·9965408	63·0	·0002944	38·0	·0039744
88·0	·9966144	62·5	·0003680	37·5	·0040480
87·5	·9966880	62·0	·0004416	37·0	·0041216
87·0	·9967616	61·5	·0005152	36·5	·0041952
86·5	·9968352	61·0	·0005888	36·0	·0042688
86·0	·9969088	60·5	·0006624	35·5	·0043424
85·5	·9969824	60·0	·0007360	35·0	·0044160
85·0	·9970560				

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German Silver.

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Coeff. for 1° below 65° F. = 1·00025 = log. 0·0001083.
„ 1° above 65° F. = 0·99975 = log. $\bar{1}$·9998917.

Temp. Fahr.	Log.	Temp. Fahr.	Log.	Temp. Farh.	Log.
110	$\bar{1}$·9951265	84·5	$\bar{1}$·9978881	59·5	0·0005956
109·5	·9951806	84	·9979423	59	·0006498
109	·9952348	83·5	·9979964	58·5	·0007039
108·5	·9952889	83	·9980506	58	·0007581
108	·9953431	82·5	·9981047	57·5	·0008122
107·5	·9953972	82	·9981589	57	·0008664
107	·9954514	81·5	·9982130	56·5	·0009205
106·5	·9955055	81	·9982672	56	·0009747
106	·9955597	80·5	·9983213	55·5	·0010288
105·5	·9956138	80	·9983755	55	·0010830
105	·9956680	79·5	·9984296	54·5	·0011371
104·5	·9957221	79	·9984838	54	·0011913
104	·9957763	78·5	·9985379	53·5	·0012454
103·5	·9958304	78	·9985921	53	·0012996
103	·9958846	77·5	·9986462	52·5	·0013537
102·5	·9959387	77	·9987004	52	·0014079
102	·9959929	76·5	·9987545	51·5	·0014620
101·5	·9960479	76	·9988087	51	·0015162
101	·9961012	75·5	·9988628	50·5	·0015703
100·5	·9961553	75	·9919170	50	·0016245
100	·9962095	74·5	·9989711	49·5	·0016786
99·5	·9962636	74	·9990253	49	·0017328
99	·9963178	73·5	·9990794	48·5	·0017869
98·5	·9963719	73	·9991336	48	·0018411
98	·9964261	72·5	·9991877	47·5	·0018952
97·5	·9964802	72	·9992419	47	·0019494
97	·9965344	71·5	·9992960	46·5	·0020035
96·5	·9965885	71	·9993502	46	·0020577
96	·9966427	70·5	·9994043	45·5	·0021118
95·5	·9966968	70	·9994585	45	·0021660
95	·9967510	69·5	·9995126	44·5	·0022201
94·5	·9968051	69	·9995668	44	·0022743
94	·9968593	68·5	·9996209	43·5	·0023284
93·5	·9969134	68	·9996751	43	·0023826
93	·9969676	67·5	·9997292	42·5	·0024367
92·5	·9970217	67	·9997834	42	·0024909
92	·9970759	66·5	·9998375	41·5	·0025450
91·5	·9971300	66	·9998917	41	·0025992
91	·9971842	65·5	·9999458	40·5	·0026533
90·5	·9972383	65	0·0000000	40	·0027075
90	·9972925	64·5	·0000541	39·5	·0027616
89·5	·9973466	64	·0001083	39	·0028158
89	·9974008	63·5	·0001624	38·5	·0028699
88·5	·9974549	63	·0002166	38	·0029241
88	·9975091	62·5	·0002707	37·5	·0029782
87·5	·9975632	62	·0003249	37	·0030324
87	·9976174	61·5	·0003790	36·5	·0030865
86·5	·9976715	61	·0004332	36	·0031407
86	·9977257	60·5	·0004873	35·5	·0031948
85·5	·9977798	60	·0005415	35	·0032490
85	·9978340				

TRANSMISSION OF POWER.

THE Basle correspondent of *Industries* writes:—"Whilst M. Marcel Deprez in Paris has from time to time announced that he has at last succeeded in accomplishing the wonderful feat of transmitting so many horse-power over an ordinary telegraph wire, we have here quietly, and in an unobtrusive way, done what it appears the great French *savant* is still striving in vain to do. In a little place called Dorenberg, close to the railway from Lucerne to Berne, there is an old iron-works and a flour mill which received water power from a joint canal, having a fall of 33 feet, and yielding about 250 H.P. There is also the facility for increasing both the quantity of water and the fall at very slight expenditure by utilising the River Emme, and thus 400 H.P. might be obtained in future. At present, however, the 250 H.P. alone are utilised by a society which was constituted some time ago in Lucerne, and which has for its object the supply of electric light and motive power to the town and its neighbourhood. The motive power is obtained at the mill in Dorenberg, by means of a Girard turbine, made by Messrs. T. H. Bell and Co., in Kriens. Its speed is controlled by a governor, which acts upon a throttle valve, and by a new type of regulator actuated by water power invented by Herr Schrieder. The regulation is so perfect that a sudden drop in the power required of even as much as 100 H.P. only results in a difference of speed of 2 per cent. Of the total 250 H.P. 60 H.P., are transmitted to a distance of nearly two miles, and are to be utilised in an establishment known as the Fluhmühle, near Lucerne. This is done by means of an electric current, conducted along a copper wire of 380 mils diameter, and supported overhead in the usual way on telegraph posts. There is a separate out-and-home circuit. The dynamos and motors for this installation have been supplied by MM. De Meuron & Guenod, of Geneva, who guarantee a commercial efficiency of 60 per cent. The power required at Dorenberg for this purpose is therefore 100 H.P. At the generating station there are two belt-driven dynamos of the Thury pattern, each of them capable of giving a current of 58 ampères at an electromotive force of 500 volts, when driven at a speed of 400 revolutions per minute. Your readers will probably know that the armature of the Thury dynamo is wound in a similar manner to that of the Elphinstone-Vincent machine, which, some years

ago, created so much stir in England. It has six poles and three pairs of brushes. The two generating dynamos are coupled up in series, and thus the pressure of 1,000 volts is obtained. The loss of pressure along the line is about 100 volts, and at the receiving station at Lucerne there are two dynamos, but of somewhat smaller size, which are also coupled in series, and from which the 60 H.P. is obtained. This is the portion of the installation which is devoted entirely to the transmission of power. Another portion of the same installation is devoted to lighting purposes, and consists of two alternating current dynamos of the Zipernowski-Deri type, each capable of delivering a current of 38 ampères at a pressure of 1,800 to 2,000 volts. These dynamos are driven by spur gear. The conductor is also placed overhead, and consists of four naked copper wires, each 240 mils diameter. Two of these serve for the out, and the other two for the home circuit. The total distance between the dynamos and the lamps is about 3½ miles. There are seven transformers distributed in the different buildings where the light is required. All the transformers are placed in multiple arc, and each is capable of producing 7,000 watts in the secondary circuit. The pressure at the terminals of that circuit is either 28 or 56 volts, according to the way of using the secondary coils. The total number of lamps now in use is 1,200, consisting partly of 10-candle and partly of 20-candle lamps. The smaller lamps require 28 volts, and the larger lamps 56 volts. They are all of the Swan type. In order to be able to use either the small or the larger lamp, all the buildings have been fitted up on the three-wire system, and the difference of pressure from wire 1 to 2, and that from wire 2 to 3, is 28 volts, whereas the difference of pressure from wire 1 to 3 is 56 volts. Thus, the consumer has it in his power to use either 28 or 56 volts for his supply. Wires 1 and 3 are connected with the terminals of the secondary coil, wire No. 2 is connected with the middle of that coil, and thus the difference in the pressure between the three wires is obtained. This electric light installation has been fitted up by Messrs. Ganz, of Budapest, at a cost of £12,000, and was started on the 19th June. This is certainly the largest installation with transformers which has yet been attempted, and if it continues to work well in future, it is very likely that many similar installations will follow, because we have in Switzerland an abundance of water power, which might thus be utilised."

TIMING BICYCLE RACES BY ELECTRICITY.

E. H. FOOTE of the Massachusetts Bicycle Club has submitted to President Ducker a scheme for obtaining absolutely correct timing of races, and it is said to be so practical and ingenious that the club will put it into practice. The details are as follows :—

Take a strip of rubber 2½ to 3 inches wide and $\frac{1}{16}$ inch thick, long enough to cross the track. Sew or rivet on one side of this two strips of thin sheet brass or copper. Fold the two sides of the strips together, metal strips inside, and sew together. In use fasten one end to the ground on the opposite side of the track to the judges' stand, the other end to the ground on the side next the stand. This end to be attached to a block of wood or rubber having binding screws connected with the metal strips. These screws are also connected in circuit with a battery, and a loud, single stroke-bell. The strips are kept apart at the opposite end by a wooden plug if necessary. The riders to be started with their wheels just in contact with the strips. Whenever there is pressure enough put on the rubber to place the metal strips in contact, the bell will sound. The starting time to be taken at the first stoke of the bell when the first man crosses, as there would be a slight variation in the men getting away, and the rear wheels would also cause a stroke. The time of finish to be also taken by stroke of the bell. The time between the strokes of the bell would be absolutely correct, and could probably be taken more accurately than by the eye. This system could be extended by putting in the battery circuit a recording instrument which would automatically and accurately record on paper each and every time, however many men there might be in the race. This would necessitate quite an additional expense, as the recorder would have to be actuated by an accurate time-piece.

GUTTA PERCHA.

OUR attention has been called to an article in the *Annales Télégraphiques* for May—June, 1886, by M. Seligman-Lui on the various specimens of gutta percha which came under his notice during his researches in the East in 1881 on behalf of the French Government.

In the September—October number (1883) of the above-mentioned journal M. Seligman-Lui published his report to the Minister of Posts and Telegraphs on the gutta percha producing districts of the eastern coast of Sumatra (see REVIEW for April 12th, 1884), and in the same publication for September—October, 1885, appeared an article by Dr. Burck, a distinguished Dutch naturalist, giving the results of his explorations through the gutta percha regions of the western coast of Sumatra, and he supplemented this article by the publication of a pamphlet in 1885 (E. I. Brill, Leyden) on the various species of gutta percha found in the Dutch Indies. In order therefore to compare the specimens collected by himself with those mentioned by Dr. Burck, and with the view of identifying some not referred to by the latter, M. Seligman-Lui sent his specimens, together with a quantity furnished him by Dr. Burck, to M. Vasque, of the Museum of Natural History, a *savant* well known for his experience in botanical research, and who has given particular attention to the investigation of the forms and varieties of the gutta percha plant.

M. Vasque has identified the specimens sent to him as belonging to seven species, many of the plants being merely varieties of the same species, differing from one another through climate, position, and other local causes.

With the exception of the Sundek or Balam Baringin, known to botanists as the Paena Leerii, and inhabiting the western coast of Sumatra, all the species belong to the family of Palaquium, and are classified as follows :—

1st species—

a. Palaquium oblongifolium Burck (Sumatra).
b. „ Calophyllum Pierre (Borneo).
c. „ oblongifolium (Sumatra).
d. „ „ (Sumatra).*
e. „ „ (Sumatra).*
f. „ Selindit Burck (Sumatra).

* Distinct, but closely allied to the preceding.

The above forms of this species were known to M. Seligman-Lui under the native names of :

A. Mayang Derrian—Getah Taban Merah—Njatouh Balam Tembaya—Balam Dourian.
B. Mayang Batou.
C. „ Djerindjing.
D. „ Kartas.
E. „ Korsik.
F. „ Sikkum.

2nd species—Palaquium Gutta (Singapore).
3rd species— „ Pierrei Burck (Borneo).
4th species— „ Bancanum Burck (Banca).
5th species— „ Xantochymum Pierre (Borneo).
6th species— „ Celebicum Burck (Celebes).
7th species— „ Oxleyanum Burck (Borneo).

M. Seligman-Lui's report deals almost exclusively with the the Paena Leerii, with the Palaquium oblongifolium Burck, and with the Palaquium Calophyllum

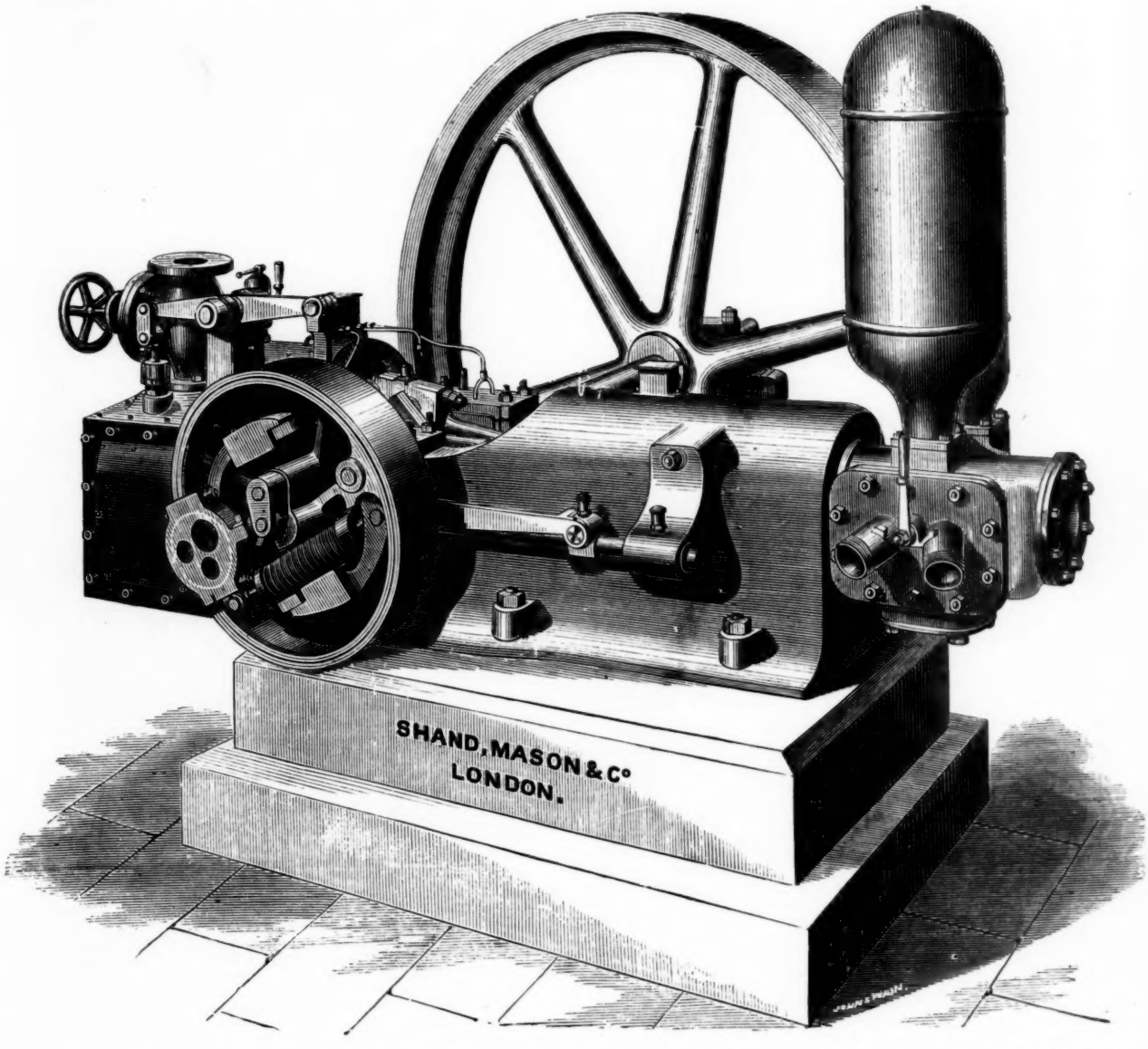
Pierre, as being the varieties best known to commerce, and containing the most valuable properties. His investigations lead him to believe that the districts which produce really good gutta percha are far more limited in area than hitherto supposed, and that unless cultivation of the better varieties is seriously undertaken, they will soon become extinct. He cites the case of the Palaquium Gutta (Isonandra Gutta Hookerii), of Singapore, which till lately was considered the Gutta Percha plant *par excellence*, but which now has completely disappeared from the forests of that island. From the experiments which have been carried out, M. Seligman-Lui draws the conclusion that no cultivation, no change of soil or climate, will transform an inferior variety into a valuable one.

The Dutch Government is experimenting on a large scale at Buitzenzorg (Java) on the cultivation of the gutta percha plant, and up to the present it has been very successful with the following varieties: Palaquium Gutta (Isonandra Gutta Hookerii) from Singapore, the Palaquium oblongifolium and the Paena Leerii from Sumatra, the Palaquium Treubii, and the Palaquium parrifolia from Banca, and the Palaquium Borneense from Borneo.

The plantations are situated about 2,000 feet above sea level, and some 4,000 plants have been reared, their satisfactory growth placing beyond doubt the ultimate success of the experiment.

COMBINED ELECTRIC LIGHT MOTOR AND FIRE ENGINE.

MESSRS. SHAND, MASON & Co., the well-known makers of fire-extinguishing machinery and appliances, have designed an engine which, while adapted for driving dynamos for electric lighting, is also available on emergency as a steam fire-pump. One of these engines has been running satisfactorily, since 1882, in connection with the electric lighting of Messrs. Holden and Sons' spinning mills at Rheims, and others have been supplied also. The readiness with which it can be altered to a fire-pump adds much to its value as a protective adjunct, especially where there is a system of mains laid through the mill or building in which it is fixed. From the pistons of the steam cylinder two rods engage with a crosshead, this latter having adjustable sliding blocks with large bearing surface. The connecting-rod returns from a pin in this crosshead to the crank shaft, one end of which carries the fly-wheel and the necessary driving pulleys. The opposite end has a governor of the Hartnell type, with several important improvements, by means of which the strain on the governor is greatly reduced for controlling the variable cut-off to suit the work being done by the engine. The main sliding valve is worked by an eccentric, and has through ports at right angles to those on the main face. The cut-off valve is fitted at the



back of the main valve, and has a motion at right angles to it. The ports through the cut-off are narrow grids, and the movement of the valve is short. The cut-off valve rod is connected to one end of a rocking lever, the other end of which is coupled to the rod of the cut-off eccentric, this latter having a pin in a bearing in the governor drum. This eccentric vibrates to a position for early and late cut off, which movement is regulated by a lever connected to a rod and eccentric, the latter being moved by the governor arms. This arrangement gives the governor complete control over the cut-off eccentric, whereas the cut-off eccentric is incapable of affecting the governor arm; moreover, the moving parts are balanced by the rocking lever, and the work of the slide valve is very light, the stroke being short. The speed of the engine is 250 revolutions per minute. Self-acting lubricators are fitted to all the working parts and the wearing surfaces made specially large. The fire-pump piston-rod is connected to a screwed projection on the crosshead of the engine by means of a swivel nut, a ratchet on which prevents any danger from slacking back. The pump delivers 450 gallons per minute, at a pressure of 180 lbs. per square inch, and will throw a $1\frac{1}{4}$-inch jet to a height of 170 feet.

ON A PHYSIOLOGICAL CONDITION AFFECTING PHOTOMETRIC MEASUREMENTS.

IT is already known (writes M. Aug. Charpentier in *Comptes Rendus*) that the comparison of two lights of different colours gives results which are variable according to the absolute intensity of these two lights. The more refrangible colours appear relatively more intense than the less refrangible colours when the absolute intensity is weakened, and inversely. But there is another phenomenon which is produced in a contrary direction and which may, under certain conditions, counterbalance the influence of the former.

Let us consider two luminous sources, the one red and the other green; by a convenient regulation of their distance let us bring them to form upon the screen of the photometer two luminous spots of equal intensity. This apparent equality is produced only for a certain dimension of the two luminous spots and for a certain distance of the screen from the eye. If the two surfaces compared are rendered larger, the green will appear more intense, whilst if their extent is reduced, the red will have the advantage.

In the same manner if we approach the screen so as to have the images on the retina larger, the green surface will seem the most luminous, whilst the red will gain the advantage if we withdraw from it.

This experiment, if repeated with different colours, gives always this result, that for a smaller retinal image the least refrangible colours appear relatively the most intense, and for a larger retinal image the colours nearest the violet-blue extremity predominate in relative intensity. The removal of the eye or diminution of the object is equivalent therefore to a diminution of the light in question, but to an unequal diminution according to the nature of the light, the decrease being slowest for the least refrangible colours.

These facts are in connection with the following. I have established for the minimum perceptible as light the same variations under the influence of the extent of the retina excited as those which I have previously discussed concerning the minimum perceptible as colour. In a memoir dated January 11th, 1881, I said that if we determine the chromatic minimum corresponding to smaller and smaller retinal images, this minimum increases more and more, but unequally. It augments more quickly for the blue than for the green, and for the green than for the red. Two years afterwards I extended and confirmed these experiments by introducing the spectral yellow (ray D), and I found that this colour takes place between the red and the green.

I have just found that the same facts are reproduced for the minimum perceptible as light, that is to say, that for every simple light the minimum perceptible increases as the excited surface of the retina decreases, but that this increase is so much the less rapid (the luminous intensity declines so much the more rapidly) as the light in question is less refrangible.

These phenomena are especially marked when the retinal image has an extent not greater than that of the *fovea centralis*, about $\frac{2}{1^0}$ths of a millimetre in diameter.

SCIENTIFIC EXPERTS AS WITNESSES.

LET us look at this question as it presents itself to men of science, alike to the chemist, the physicist, the mechanician, the geologist, the physician and the microscopist, though certainly not to the astronomer, who is in no danger of being called, as such, to give his testimony. The expert occupies a totally anomalous position in Court. Technically he is a mere witness; practically he is something between a witness and an advocate, sharing the responsibilities of both, but without the privileges of the latter. He has to instruct counsel before the trial and to prompt him during its course. But in cross-examination he is the more open to insult because the Court does not see clearly how he arrives at his conclusions, and suspects whatever it does not understand. The late Dr. R. Angus Smith complained of being "contemptuously compelled to herd with thieves and scoundrels in a witness-box." He adds: "I have seen barristers speaking to a scientific witness in such a way as to show that to them a witness was always an inferior person." Surely every person who has been present at a technical trial, or has had to appear as an expert in a poisoning, a patent, or an adulteration case, will be able to confirm this from his own observation and experience.

Now it may, perhaps, be cynically hinted that men of science should be willing to bear all this annoyance for the public good. But is it for the public good? In the first place, not a few of the most eminent men in every department of science distinctly and peremptorily refuse to be mixed up in any affair which may expose them to cross-examination. "I will investigate the matter, if you wish it, and will give you a report for your guidance, but only on the distinct understanding that I am not to enter the witness-box." Such in substance is the decision of not a few men of the highest reputation and the most sterling integrity. Certainly it is not for the interests of justice to render it impossible for such men to give the Court the benefit of their knowledge.

Further, the spectacle of two men of standing contradicting or seeming to contradict each other in the interests of their respective clients is a grave scandal. Men of the world are tempted to say that "Science can lay but little claim to certainty, and is rather a mass of doubtful speculations than a body of demonstrable truth." To us, at least, there is nothing more saddening than to read the trial of a notorious poisoner, or the report of a great patent case, especially if taken along with the comments of the Press and of society on these occasions.

Here, then, we see that our present mode of dealing with scientific evidence is found on all hands unsatisfactory. The outside public is scandalised; experts are indignant; the bench and the bar share this feeling, but unfortunately are disposed to blame the individual rather than condemn the system.

But we fear that this unanimity of dissatisfaction will vanish as soon as a remedy is seriously proposed. To that, however, we must come unless we are willing to dispense with scientific evidence altogether.

As it seems to us, the expert should be the adviser of the Court, no longer acting in the interest of either party. Above all things he must be exempt from cross-examination. His evidence, or rather his conclusions, should be given in writing, and accepted just as are the decisions of the bench on points of law.

Here for the present we must invite the suggestions of our readers, hoping to arrive at some definite result from their collective wisdom.—*Chemical News.*

THE GREAT ILLUMINATED FOUNTAIN ON STATEN ISLAND.

ONE of the greatest attractions at the recent exhibitions in London has been, says the *Electrical World*, the illuminated fountain designed by Sir Francis Bolton. In this the most beautiful spectacular effects were produced by means of the electric light, which was thrown into and upon the streams of water, and made to vary with all the colours of the rainbow.

Within a week a similar fountain will be put in operation on the grounds of the Staten Island Amusement Company, and the arrangements which have been made will, without doubt, place this one far ahead of the former in point of beauty and size.

The basin of the fountain is 120 feet square, and below its level in the centre there has been constructed an apartment

40 feet square, in which the apparatus for manipulating the jets and the lights has been placed. This apartment is entered by two tunnels, and is 8 feet in height, so that it allows of ample opportunity for easy manipulation. The roof thus constitutes the bottom of the fountain, and through it 15 apertures have been made and glazed, each 24 inches in diameter. These are all covered with stout glass and made watertight. Below each is placed an arc lamp of 8,000 C.P. The light from each will be reflected directly upward into the stream of water, which is projected from nozzles placed exactly over the centre of the apertures. In this manner the light will, by internal reflection, be kept entirely within the stream of water, and as the jet breaks at the top most beautiful effects are obtained.

In front of each aperture is a shelf upon which horizontal screens of coloured glass are placed, moving upon rollers, and all of which in the same line are connected together. In this way a single movement changes the colour of a corresponding number of jets, so that a large number of combinations are possible with the 15 lights.

All the jets are controlled by valves, and they can be varied *ad libitum* for different effects. Besides these powerful lamps below the fountain, a beam from a search light placed in an adjoining tower will be thrown upon the water. Moreover, thousands of Edison incandescent lamps, placed in artistic arrangement about the fountain, will add to the rare beauty of the scene.

With the water pressure available, viz., 75 lbs. to the square inch, and a full supply from a 10 inch main, a height of probably 150 feet will be attained by the jets. Situated upon an elevation overlooking New York Bay, this beautiful piece of work cannot fail to attract visitors, especially as all will be permitted to inspect the full operations.

Some idea of the magnitude of the enterprise can be obtained from the statement that it will require 25 men to operate the fountain alone, and by way of comparison we may mention that while in this case 15 arc lamps are employed under the fountain, in London the fountain has had only five.

The whole grounds and buildings are to be lighted by electricity, and in order to permit of games being played at night, the large base-ball field has been encircled by arc lamps at short intervals. The adjoining buildings and grand stand have about 500 incandescent lamps distributed among them, so that there will certainly be no lack of light. The power installation consists of four Armington and Sims engines, aggregating 250 horse-power, and seven dynamos, of which two are incandescent machines. The work has been carried on under the general supervision of the well-known lighting expert, Mr. L. Stieringer, and the incandescent and arc lights are respectively on the Edison and Brush systems, the installation of the arc lights being in the hands of Mr. William M'Grath, of the Brush Company, New York, and the incandescent wiring by Messrs. Noll Bros.

We may add that the power plant also furnishes current for 50 arc lamps which are situated five miles distant in Erastina, another pleasure resort shortly to be opened by the enterprising Mr. Erastus Winam, the originator of the one above described.

INCANDESCENT LAMP PATENTS.

EDISON *v.* WOODHOUSE AND RAWSON
AND
EDISON AND SWAN UNITED ELECTRIC LIGHT COMPANY *v.* WOODHOUSE AND RAWSON.
(*Before* MR. JUSTICE BUTT, *sitting for* MR. JUSTICE NORTH.)

(*Continued from page* 64.)

Friday, May 14*th*, 1886—(*continued*).

THE SOLICITOR-GENERAL: Having told my learned friends and your lordship the position in which I am placed with regard to the infringement of the first claim, which is confined to the carbon filaments made as described, and having reminded your lordship of the very slender evidence there is, resting, I think I am entitled to say, merely on Sir Frederick Bramwell's belief, I think I may pass on now to something else. I have very nearly done with Edison's patent, but I desire to say a few words on the third claim, which I say is also anticipated. The third claim is: "A coiled carbon filament or strip arranged in such a manner that only a portion of the surface of such conductor shall radiate light as set forth." I assume that that is intended, although it does not say so, for a coiled carbon filament or strip to be used in an incandescent lamp. I submit that that has been anticipated by Pulvermacher and by Van Choate.

MR. JUSTICE BUTT: Is it said that the defendants have infringed this third claim?

THE SOLICITOR-GENERAL: No; there is no allegation that we have infringed the third claim. But if I can show that the claim is bad——

MR. JUSTICE BUTT: Oh yes; but there is no allegation.

THE SOLICITOR-GENERAL: No. The claims we are alleged to have infringed are the first, second and fourth, and I think without prejudicing my learned friends in any way, I may say that there is no evidence of infringement of the fourth claim at all. I challenged my learned friends yesterday, and they did not point it out then.

MR. ASTON: There is no infringement of the fourth unless there is an infringement of the second, if that is what you mean.

THE SOLICITOR-GENERAL: I will deal with the second claim when I come to it.

MR. JUSTICE BUTT: Now you are on the third claim, and are referring to Pulvermacher's specification.

THE SOLICITOR-GENERAL: We are not alleged to have infringed this, and as I read the third claim there can be no dispute about it. It is a claim for the spiral burner, as used, I admit, in an incandescent lamp. At page 5 of Pulvermacher he says: "My improvements relate to various apparatus for the production of electric light varying according to the method employed either lighting by the voltaic arc or by incandescence. For lighting by the voltaic arc the principal organ or medium I employ is composed of two parts, invariably connected together, which I term the rod spiral. The central portion of this rod consists of a thin rod composed of a paste or compound of fine powdered pure charcoal mixed with tar and pitch, or by compression of lampblack, and obtained by pressure through a draw plate. The surrounding or enveloping part consists of a thinner carbon rod or thread also obtained by pressure through a draw plate. The thin rod is provided in course of manufacture with a central textile thread, forming a kind of core and giving strength to the carbon. The said enveloping or surrounding rod in a malleable state and provided with its interior textile thread is wound in spiral coils around the central rod leaving about one millimetre between the coils, so that they do not touch each other. The central rod should be previously coated with an insulating and refractory material, as for example plaster, mica, asbestos, and the interstices formed by the separation of the coils, may also be filled by an insulating and refractory material. The rod spiral, which is obtained by means of the central rod forming the core and of an enveloping or surrounding rod wound in spirals, is placed in a box filled with powdered or pulverised carbon, or other suitable material, for the baking operation. I thus obtain rod spirals of indefinite length, according to the size of the apparatus to which they are applied, and having remarkable solidity resulting from the combination of the adherence of the central rod with the spiral around it." I am perfectly aware that that applies to some method of arc lighting. My point is, that you have there described a means of making a spiral thread out of tar and pitch almost identical in terms with the mode described by Mr. Edison, and that there is no earthly reason why a person should not take this rod spiral, as Pulvermacher calls it, and put it into an Edison lamp. In fact, it would be exactly the same thing as Edison's spiral, so that if the first claim be for the mode of manufacturing the spiral, there you have the mode. The only difference is, that instead of winding it round a central rod or putting a central rod into it, you take the spiral and use it as a burner.

MR. JUSTICE BUTT: He has more than one method; he does it either by the voltaic arc or by incandescence.

THE SOLICITOR-GENERAL: Yes; I agree that my friend is right in saying that Pulvermacher does not propose to use his spiral as a burner in an incandescent lamp. I confine myself to the negative and say Edison does not show any invention. You have here described a spiral made of the same substance and of the same consistency as Edison describes it. You have a spiral which is formed or coiled into its spiral shape before carbonisation; that is, which after being formed into that spiral shape is carbonised. You have even that small incidental advantage which Edison pointed out, that he sometimes rolls a thread in the putty-like paste in order to give it greater consistency. That is not his language, but that is the effect of it. What information was there to a person acquainted with Pulvermacher's invention in saying that that is a suitable form in which carbon can be used in an incandescent lamp? Could a man take out a patent for a new mode of making carbon conductors by simply saying "I use Pulvermacher's spiral as a carbon conductor." If he could not, then he could not, by describing it over again without reference to Pulvermacher, do the same thing. If he had said, "Pulvermacher's spiral is an excellent spiral, and I have discovered that it can be used as a burner in an incandescent lamp," without varying one jot or one tittle of the description given by Pulvermacher, and if that would not be a good patent, then he cannot make it a good patent by describing the same thing over again in his own language. Of course there was no novelty in using spirals as burners in incandescent lamps, because Lane-Fox had done exactly the same thing with wire. There is one other anticipation of this, and that is Van Choate's. I think it right to tell your lordship, in order that I may not labour under the imputation of making a false point, that there is a contest between the scientific gentlemen whether this patent is intended for an incandescent lamp or an arc lamp. I think those of my learned friend's witnesses to whom it was put thought it was intended for an arc lamp. The scientific gentlemen who assist me say that it is clear that it is intended for an incandescent lamp. Van Choate begins by saying that his invention "relates to a novel method and apparatus chiefly designed for use in the electric lighting, but which is also partly applicable for telegraphic and other electrical purposes. My invention relates partly to an improved illuminator apparatus for developing light from an electric current." Then he goes on: "The substance or material which I employ to form my illuminator or burner, and which is to give the illumination by the action of the electric influence, is composed or formed of asbestos, mica, platinum, or carbon, or any combination of them, and such other materials as may be required to give the proper affinity and homogeneousness to the material. These materials are mixed

and prepared to form a metallic or semi-metallic material which becomes incandescent under the influence of electricity and gives or forms the illumination, but which, practically speaking, does not volatilise, melt, or fuse under the influence of the electric current, made into wire." Your lordship remembers Mr. Edison calls his "a wire." "This metallic or semi-metallic substance or material is preferably made into wire or ribbon of proper size and formed into arcs, spirals, or spiral globe-shaped illuminators or burners." That is an arch, in fact. It has nothing to do with arc lighting, but it is in the form of an arch. "Or the material may be formed into discs or globes or spirals wound around a central wire or body, or into other shapes, required to form the light. The same will be placed or inserted at the point or points in the electric circuit in which it is desired to produce the light, and when these illuminators are placed in the proper position the light can be produced by turning the electricity through them; and to extinguish light the electricity has simply to be turned off. By the employment of my illuminator the necessity of changing or inserting new carbon burners, cokes, carbons or other devices at intervals is entirely obviated." Passing on to line 16 on page 2 of the specification: "In carrying this part of my invention into practice for electric lighting, I first ascertain or determine the number and power of the lights, lamps or illuminators to be used in each circuit, and then ascertain and determine the amount of electrical resistance that will be required at each lamp or point of illumination to produce the electric arc or light." That, I am instructed (I do not know whether my learned friends differ from it), has nothing to do with electric arc lighting, but means only that the burner is in the shape of an arch. "That is to say, the amount of resistance necessary to render incandescent the burner, carbon, metal, or other substance used for giving or developing the light. The sum of these quantities of resistance, added to the resistance of the wire or conductor will be the total resistance in the circuit." There I venture to submit you have described a substance which may be of pure carbon formed into either the arc, which I construe to mean an arch, or a spiral, or any other shape for the purpose of being an illuminator or burner by the passage of a current of electricity through it. So much with regard to the third claim. Now I come to the fourth claim. My answer to the fourth claim is, that we know very little about it. We have not had the advantage of either seeing Mr. Edison, the patentee, and having an explanation from him, nor have we had the advantage of seeing any practical manufacturer or any person engaged in the manufacture of these lamps who will explain to us what the fourth claim is, or how it is intended to be carried into effect; but so far as we can understand it, it appears to be a separate claim. The first claim includes the combination of the mode of manufacturing the carbon burner with the means of securing it to the metallic wires. The fourth claim claims the mode of securing the platinum contact wires to the carbon filament and carbonising the whole in a closed chamber substantially as set forth. It appears to be a claim for securing the platinum wire before carbonisation. My first answer to that is, that I do not infringe it. I said yesterday, before I addressed your lordship, in order that I might clear the ground, that there was no evidence, and I repeat it.

Mr. JUSTICE BUTT: I do not recollect any evidence certainly that the means described in this patent were used.

The SOLICITOR-GENERAL: I should be afraid to state the negative on my own authority.

Mr. ASTON: We do not say there is any.

The SOLICITOR-GENERAL: I will not say anything about the fourth claim. I do not think there is any evidence touching it.

Mr. JUSTICE BUTT: No evidence of infringement. But I do not say that there will not be.

The SOLICITOR-GENERAL: No, my lord, I am not going to open evidence against myself. I will not pursue that any further. That concludes what I have to say on Edison's patent. As it is pointed out to me, I want that point clear to your lordship's mind, that if there be no evidence of the infringement of the fourth claim, that is to say, if there be no evidence that the mode of securing the burner in the defendant's lamp is similar to or the same as that described in Edison's patent, that would not be infringement of the first claim, because the first claim is for the combination of the burners made as described. That concludes what I have to say upon Edison's patent, which is the principal part of the case, and I have to submit for the reasons I have stated that Edison's patent is void in law. No doubt Mr. Edison believed he had discovered a valid improvement in electric lighting, but he was not aware of what had been done previously; he was not aware of the improvements which had been made from time to time; he was not aware of the work which had been done by Lane-Fox, by Swan, and other gentlemen, and he is endeavouring to claim for himself a monopoly to which he is not entitled. And, my lord, I venture to submit, in the language used in Ralston *v.* Smith, that it is not every valuable discovery which forms a proper subject matter of a patent, or which entitles a man to a patent for his discovery as a new manufacturer, and that, giving the utmost latitude my learned friend could ask to be given to Mr. Edison's second claim, I say that it does nothing whatever more than indicate the best mode, giving a practical direction for manufacturing the incandescent lamp by reducing the size of the carbon burners, and telling people that they will gain certain advantages if they reduce the size of the carbon burners. I say that a practical direction of that kind, it being open to all the world to use carbon burners, does not form the proper subject matter of a patent, and that it is void on that ground if on no other. I shall be very short on Swan's patent. Your lordship knows what that patent is. Fortunately it is a very short one and a very intelligible one. I have endeavoured, and I hope successfully, to destroy Edison by means of Swan, and I am now going to destroy Swan by means of Edison, and I think, although I do not like to be too confident in a case of this kind, I cannot help thinking that I shall have the assistance of my learned friends, Sir Richard Webster and Sir Frederick Bramwell, and Mr. Imray, in my bold attempt. Sir Richard Webster admitted very fairly and very candidly, as he was sure to do, in his opening, that he felt great difficulty on the subject, but I understood him to suggest that there was some difficulty in Edison's patent as an anticipation of Swan's. I think he must have been under some mistake as to dates.

Sir RICHARD WEBSTER: That was with regard to Edison No. 4,576, on which we are saying, that was not published. I admitted that 2,402 was published. The point only arises with regard to 4,576.

The SOLICITOR-GENERAL: Yes, but I do not rely on that as an anticipation of Swan's.

Sir RICHARD WEBSTER: I only want to say that at that time the specified number 4,576 was not public knowledge.

The SOLICITOR-GENERAL: If what Swan made had been described in an earlier provisional specification it would be only a difference in the form of pleading. Instead of being "prior publication" it would be "not the first and true inventor." However, the point does not arise here, because the process which Mr. Swan describes, a very useful process, I know, that of running the pumps for the purpose of getting rid of the occluded gases, had been described in the clearest possible terms by Mr. Edison himself in his patent No. 2,402, and he had told us in that patent that it could be applied to freeing carbon sticks from air. He describes it particularly with regard to a wire burner, and then says: "Carbon sticks may be freed from air in this manner, and," he adds (which is interesting) "be brought to a temperature at which the carbon becomes pasty, and if allowed to cool it becomes very homogeneous and hard." With regard to that, I shall do nothing more than read the evidence of Sir Frederick Bramwell and Mr. Imray. On the second day Mr. Charles read the specification No. 2,402 to Sir Frederick Bramwell. Then he asked this question upon it after reading down to the words "homogeneous and hard": "Now this invention of Edison's anticipates, does it not, the invention of Mr. Swan? I do not suppose he knew it." I must remind your lordship that Sir Frederick Bramwell had told us in chief that he had looked through and carefully considered all the patents which were said to be anticipations of the patent sued upon, and he is asked this question. Sir Frederick Bramwell, to do him justice, is not always averse to giving the fullest explanation when he thinks it proper to do so, but on this occasion he was extraordinarily reticent. He says: "That appears to me to be a matter for his lordship. There it stands. I offer no evidence upon it." Mr. Charles tried to get a little more from Sir Frederick Bramwell, but he is not the only person who has found it difficult to extract an opinion from Sir Frederick Bramwell when he did not think fit to give one. [Having read further extracts from the evidence, the Solicitor-General proceeded]: I claim Sir Frederick Bramwell to that extent as my witness. I claim your lordship's judgment on Sir Frederick Bramwell's evidence that Edison did describe a mode of freeing carbon as well as platinum conductors from the occluded gases prior to the date of Swan's patent. But I have also Mr. Imray's evidence, and Mr. Imray was not quite so reticent and perhaps not quite so discreet as Sir Frederick Bramwell. [The Solicitor-General quoted from the evidence of Mr. Imray upon this point, and went on]: I am not going to trouble myself about Swan's patent after the evidence of those two gentlemen. There is this further observation to be made, which I afterwards put to Mr. Imray, and his suggestion that carbon sticks were to be freed from air for the purpose of arc lighting, if he will forgive me for saying so, shows the extremity to which he was driven. Unless you were going to seal your carbon conductor in vacuum it would be no use freeing it from air, because if you left it exposed to the air the greater part of it would come back again. I venture to submit that Edison's patent 2,402, by the admission of the eminent persons whose evidence I have referred to, is a complete answer to what Mr. Swan supposed himself to have discovered and described in the patent sued upon. My learned friend Mr. Macrory says that there is no evidence of any infringement of Swan's patent, and now he reminds me of it I certainly do not remember any. I am afraid I was so greatly impressed with the completeness of the anticipation that I did not direct my attention to that point.

Mr. MACRORY: I do not recollect any evidence.

Mr. JUSTICE BUTT: It is not your business to recollect.

Mr. MACRORY: But we sometimes do more than our business, my lord.

Mr. ASTON: I will tell your lordship to-morrow morning how it stands.

The SOLICITOR-GENERAL: Then the only other point I have to deal with is Mr. Gimingham's patent. I confess, and I say so, of course under the full sense that I shall be contradicted at every point, that it seems to me that Gimingham's patent labours under every infirmity which it is possible for a patent to have. It is not a proper subject matter of a patent, it is not new, it is not useful, and the specification is insufficient. I will again call the unimpeachable testimony of Sir Frederick Bramwell. He was asked about this in cross-examination. Mr. Charles asks him if it is anything more than the application to the platinum wire where it joined the filament, of an ordinary mechanical device,

and he replies: "I say it is a simple and meritorious mode of making a connection between a filament and a wire." Your lordship observes that Sir Frederick Bramwell carefully avoids answering the question. I will not say avoids, because that might appear to be imputing something which I do not desire to impute, but I will say, carefully does not answer the question. Mr. Charles says again: "Is it anything more than the application to platinum wire of an ordinary mechanical device, and a well-known mechanical advice?—(A.) No, it is not." Dr. Fleming told us that there was no novelty in the manufacture, and I think Mr. Imray admitted the same. [Having read portions of Gimingham's specification, the learned Solicitor-General continued]: That, as I understand it, and my witnesses understand it in the same way, means that you place your carbon in your socket, and without any mechanical pressure, or without making any physical union between the carbons and the platinum the joint is sufficiently made. In the case of Harwood *v.* The Great Northern Railway Company a patent had been taken out for using a fish joint for connecting the rails of a railway where they cross each other, in other words for making the points of a railway, and it was undoubtedly novel and useful. Nobody had ever applied any similar kind of joint to the making of rails before; but it was shown that Mr. Brunell had used a similar fish joint in the construction of a suspension bridge on the South Devon Railway, and that the patentee had merely transferred a known thing from one use to another, and that what he claimed as his invention was not a good ground for a patent. That is to say, if you have a well-known mechanical device, such as putting a thing into a socket to form a joint, you cannot by describing a particular use of that mechanical device get a monopoly for it.

Mr. JUSTICE BUTT: Is there any evidence of infringement of this?

The SOLICITOR-GENERAL: Yes, Dr. Fleming's evidence.

Mr. JUSTICE BUTT: You say an infringement if the same thing were used, and used with a cement?

Mr. ASTON: No, my lord.

Mr. JUSTICE BUTT: Mr. Gimingham himself says it was always used with a cement. It struck me at once that if it was a thing which was always used with a cement, the defendants had used a cement, and if the defendants have used a cement, is it an infringement?

Mr. ASTON: The way I venture to submit it to your lordship is this. For the purpose of forming connection between the cylindrical terminal——

Mr. JUSTICE BUTT: I quite understand what it is and how you put it, but I understand also that it is never used without a cement.

Mr. ASTON: No. But underneath that cement there is a tubular socket in the defendants'.

Mr. JUSTICE BUTT: But that is not his patent, if you use cement, because he professes to hold it by the string of the carbon. If that is right, I do not see what case there is in this, or why it is worth while going into it.

Mr. ASTON: I see your lordship's difficulty.

Mr. JUSTICE BUTT: Unless you can shake me, it is clear to me there is no evidence of infringement. If there is a doubt about it I must hear every point; but it occurred to me as soon as Mr. Gimingham gave his evidence that there was an end of the case for an infringement of the Gimingham patent. I do not say it is so; of course I shall hear you. I should not have thought that that very simple device, and it may be a very ingenious one, of flattening out the wire and putting it into a socket and then cementing the wires into it, was the same thing at all.

Mr. ASTON: Suppose it is admitted, or that we prove that Gimingham's socket is used, and that as far as it goes it forms a good connection, not the less would Gimingham's socket be used; but if the defendants choose to cover that over with another socket——

Mr. JUSTICE BUTT: My conclusion is that it is not a good connection without the cement.

Mr. ASTON: That goes to another objection.

Mr. JUSTICE BUTT: No, it goes to that surely, that it is not a good connection without it, else why use it?

Mr. ASTON: I can only put it in this way, that used with the cement it is a further improvement upon the basis, which consists in the socket connection. If your lordship is of that opinion I should not like to take up your lordship's time in making a point which is of minor importance, and which may be the subject of a long enquiry.

Mr. JUSTICE BUTT: What I mean is this. Mr. Gimingham specifies it thus: "Both terminals of the lamps are thus formed of the ends of the carbon, each placed on the tubular parts as shown in fig. 3, and by the combined spring of the carbon and the metal tubular parts the said carbon is held firmly in place in the said terminal." I gather that the defendants do not so make their joint.

Mr. ASTON: Oh, yes.

Mr. JUSTICE BUTT: No, they have cement as well.

Mr. ASTON: They begin with that, my lord.

Mr. JUSTICE BUTT: But if they hold it firmly by cement, I do not see how it can be said to be firmly held by the spring of the material.

The SOLICITOR-GENERAL: Perhaps I had better finish, my lord, and then your lordship can say before we go into the evidence whether you desire any evidence upon that. I will take the objection at once. I may formally say that there is no case to go to the jury upon this and that I ought not to be called upon, but, without prejudice to that, I will state what are my objections to it. In the first place, I say it is not a proper subject matter of a patent, because it is the mere application of an old mechanical device, at the utmost, to a new and analagous use; but I go further than that and say that it is only a particular use of a well-known mechanical device which all the world has been in the habit of using for the purpose of making joints. Secondly, I say it is not useful. That covers both the novelty and the subject matter, because from Mr. Gimingham's evidence, which your lordship has just referred to, it is apparent that his patent never has been used, and that it is not known to be useful, and nobody has shown that it is useful except you add nipping, which will make a physical union between the socket and the burner, or else use some form of cement. Therefore, I say it is not useful, and I may add with respect to that, if it be necessary, that the reason for that is this; that the heating of the burner after it has been incandescent for some time does not fuse, but tends to expand the platinum socket, the effect of which is that it no longer fits but becomes loose, the effect of which is, just what Dr. Fleming told us with regard to Swan's lamp, that the resistance varies because there is more contact at one point or at one time than at another, and for that reason it is not useful. Then I say, fourthly, that there is an insufficient description of it, which is only the same objection put in another form, namely, Mr. Gimingham tells us it is always used, in fact, either with nipping for the purpose of making a physical connection, or else there is a physical union of the socket and burner, or else with cement; and he has not told us that in the specification. I read the specification as if the idea of the patentee was that it would be held simply by the grip of the socket without the addition of any cement or other matter of that kind. If it cannot be used without cement, and Mr. Gimingham tells us it never has been used without cement, and I think the fair inference from the language is that it cannot be used without some form of cement, then I say there is insufficient description of it in the specification, inasmuch as he has not told the public that, but has misled the public. Then my last objection to it is that there is not sufficient evidence that we had infringed it. I am instructed to deny the infringement. The only evidence of the infringement of Gimingham's patent is contained in Dr. Fleming's evidence and in Mr. Gimingham's own evidence. I remember the effect of Dr. Fleming's evidence. He broke up a lamp which was said to be one of our lamps, and which I believe was one of our lamps, and he said looking at it, he believed the joint was made in the mode indicated by Gimingham, and then in cross-examination upon it, I asked him: "Can you tell me from the appearance of the lamp whether the platinum had been pressed by nippers or other mechanical means on to the carbon?—(A.) No. I could not gather from the appearance. (Q.) You do not know whether by the application of such mechanical force to Gimingham's socket the connection would be too uneven, too variable?—(A.) I think the platinum socket would have to be pressed round the carbon to make a joint." Then at another point: "Are you enabled to say from the examination of that lamp whether the joint has been made by the platinum being mechanically pressed round the carbon or not?"

Mr. JUSTICE BUTT: Did he not say he should understand from the specification that it was meant to do that?

The SOLICITOR-GENERAL: Yes, of course. I did not follow him in that, because what the patentee tells us is that by the combined spring of the carbon and the metal tubular parts the carbon is held firmly in place in the terminals, which I understand certainly to mean, and those who assist me in the case understand it to mean, that it was held by the natural grip of the socket. The gentlemen who assist me say that the effect of that would be to produce a looseness from the operation of the great heat of the burner on the platinum. From the alternate heating and cooling the platinum would lose its shape, to a very small extent, no doubt, but to a sufficient extent to affect the joint.

Mr. JUSTICE BUTT: Mr. Gimingham says, so far as he knows, they always used cement. I should imagine you always used cement.

The SOLICITOR-GENERAL: No, my lord, we do not. We use another device, which is a very pretty one indeed. I am sorry to have occupied your lordship's attention so long, but it is possible I may have shortened it by putting your lordship, so far as I could, in possession of the points on which I rely. I ask to be released at once from Swan's case, and from Gimingham's case; and with regard to Edison's case, I submit to your lordship that the patent is void, and that there is no infringement. There is one question I should like to answer before I sit down. Your lordship asked me, if I remember rightly, whether there was any description anywhere of any carbon filament which was flexible before Edison's patent.

Mr. JUSTICE BUTT: No. I asked whether it was flexible when it was bent. It appeared in a lamp in a bent form, and not in the shape of a rod. My question was with reference to this. It appeared to me, from all I have seen and read in this case, that the things which are called sticks, crayons, pencils, and so on, were straight pieces.

Mr. ASTON: That is so.

Mr. JUSTICE BUTT: That is why I asked whether in the documents referred to there was either a stick, a pencil, or a rod which was between the two extremes.

Mr. ASTON: No, not that I know of.

The SOLICITOR-GENERAL: I was going to tell your lordship this, and that will to a certain extent answer your lordship's question. What Sidot calls crayons or pencils are really fine flexible pieces of carbon cut in lengths ready to be used. When we put in our evidence your lordship will see some of them, and

will see the gentleman who prepared them, and will find that they are flexible pieces, or slips or filaments of carbon which are capable of being bent, if they are small enough, into any desired shape. Here, for instance, is one which has been prepared by Dr. Frankland according to Sidot's process.

Mr. JUSTICE BUTT: I do not doubt that. I suppose that is capable of being a curved conductor?

The SOLICITOR-GENERAL: Yes.

Mr. JUSTICE BUTT: But somebody has made that from Sidot's description. Is that a thing which has been in use?

The SOLICITOR-GENERAL: No, my lord.

Mr. JUSTICE BUTT: Because anybody could, I daresay, produce from Sidot's process a lamp with a flexible strip. What I want to know is whether, in any of these things which preceded the date of Edison's patent, there was any pencil, rod, or stick which was a curved and not a straight line.

THE SOLICITOR-GENERAL: There are plenty of burners composed of carbonised asbestos. My witness will bear that in mind when he comes into the witness box. I desire to point out with reference to Sidot that he did describe a process by which you can make a very efficient carbon burner in the form of a filament. Sidot's was published a great many years ago: and I should not be surprised if your lordship hears before this case is over that Sidot's is the most efficient mode of making it.

Mr. ASTON: We shall live and learn, my lord.

The SOLICITOR-GENERAL: My friend Mr. Macrory reminds me, and I ought to mention one point as to the anticipation which we rely upon of Swan's lamp. My friend Sir Richard Webster said that there was no present use. It is perfectly immaterial whether there is present use or not if the thing was published, and it was published in this way. It was described by Mr. Swan himself at three lectures to which the public were admitted, and those public lectures were afterwards reported in the local Newcastle newspapers, and in other places. It is perfectly immaterial whether it was Mr. Swan who started the trade or business of a lamp manufacturer, or if he made a discovery of something so as to put the public in possession of it.

Mr. ASTON: I shall dispute that.

The SOLICITOR-GENERAL: I do not think Sir Richard Webster will dispute it.

Mr. ASTON: Your lordship has been good enough to say that we may have till to-morrow to consider what course we will take as to Gimingham's patent.

Mr. JUSTICE BUTT: Take till to-morrow morning, and rest as you are or give further evidence.

(The Court then rose for the day.)

(To be continued.)

NOTES.

Electric Lighting in the Navy.—On Tuesday, the 13th inst., the official trial took place of the electric lighting installation on board H.M.S. *Mersey*, which is completing for sea at Chatham, and which has been lighted throughout by Messrs. Goolden and Trotter, of Westminster and Halifax. The lighting was very complete, every part being well illuminated, including magazine and light boxes, while all coal bunkers were provided with wandering leads. The internal lighting consisted of 168 lamps of 16 C.P. each; the ship was also fitted with two powerful search lights of 27,000 C.P. each, the projectors and hand-fed lamps being by Messrs. Latimer Clark, Muirhead & Co. Yard-arm reflectors (fore and aft) each contained eight lamps of 50 C.P. Mr. Farquharson attended from the Admiralty, and Mr. Apsey, electrician at Chatham, watched the trial, which lasted from 4 till 11 p.m., on behalf of the chief constructor. The switch board was Scott's patent as supplied to H.M. ships *Devastation*, *Conqueror*, &c., &c. Notwithstanding the difficulties of ship lighting, which were lately so fully ventilated in the ELECTRICAL REVIEW, the fitting of the *Mersey* was completed in less than eight weeks. At the conclusion of the trial, 11 p.m., after a run of seven hours, Mr. Apsey congratulated Mr. Scott, the engineer to the contractors, under whose superintendence the whole installation has been fitted, on the efficient manner in which the work had been carried out. With the exception of the search light cable which was by Callender and Co., the whole of the wire was made by the London Electric Wire Company.

Temporary Lighting.—At the two recent entertainments given at Grosvenor House by the Duke of Westminster, the rooms were lit with the electric light. There were in all 220 lights fixed, and the work was as before carried out by the Electrical Power Storage Company.

At the dance given by the Prince of Wales on the 21st, the Indian room was, as before, lit with the electric light. The work was carried out by the Electrical Power Storage Company.

Electric Light in Flour Mills.—Messrs. Simmons and Clifford, of Winchester, have lately introduced the electric light into their new mill at Winchester, thus making work possible by night as well as by day. With the view of diffusing a clear and penetrating light in every part of the premises, 26 Swan incandescent lamps are used. Messrs. Simmons and Clifford's new premises are in other respects excellently fitted, and between their erection and the demolition of the old mill only 17 weeks have elapsed.

Town Lighting by Electricity on the Continent.—The towns of Gastein and Gatz, it is stated, will shortly follow the example of Temesvar, in Hungary, and Hernosand, in Sweden, and be lighted throughout by electricity.

The Lighting of Offices.—The North British and Mercantile Insurance Company, of Old Broad Street, E.C., has decided to light its premises throughout with the electric light. After making enquiries it has been decided to adopt the Electrical Power Storage Company's system.

Brazilian and West Indian Cables.—The *Financial News* congratulates Mr. Thomas Fuller, the managing director of the Brazilian Submarine Telegraph Company, on the great victory he has just scored in Paris for the English telegraph industries. The Brazilian Company holds a privilege, which will last seven years longer, of telegraphic communication between Brazil and Europe. Some time ago an American company, the D. Pedro II., undertook to lay a cable between Brazil and Trinidad, there to connect it with the lines of the West India and Panama and the Cuban Submarine to Florida. But, as the West India and Panama refused any traffic agreement whatever with the D. Pedro II., the latter looked elsewhere for a footing in the Antilles, and found it in San Domingo, where a French company was in possession of a valuable privilege. That company lately proposed to reorganise itself and lay cables to Cayenne, which is now isolated, Martinique, Guadaloupe, Curaçoa, and Venezuela, and from San Domingo, directly to some convenient point in the United States. The French Government agreed to guarantee a large sum of money as interest upon the capital, and the Government Bill, signed by President Grevy and three Ministers, came before the Chambers a few days ago. It had been approved by the committee of the Budget, and the Government considered it so important that it asked urgency for its consideration. It must be a matter of congratulation for the Brazilian Submarine, Western and Brazilian, West India and Panama, and the Maintenance and Construction companies, that the Chambers by a majority of six votes in 510, refused the urgency.

Telegraph Revenue.—The receipts on the telegraph service from April 1st to July 17th, 1886, amounted to £505,000, against £525,000 from April 1st to July 18th, 1885.

A Cable Relic.—What is described as "an interesting relic of one of the world's greatest enterprises" is in the possession of Mr. H. P. Leslie, of Elkton, Maryland. It consists of a much-handled congratulatory message which Mr. Leslie, then one of the officers on board the *Niagara*, sent to his wife in Annapolis at the time when about 700 miles of the cable had been paid out from the British side. The message was one of the first sent back to Valentia Bay, and thence mailed to its destination. Shortly after it was despatched the cable parted, and the enterprise had to be abandoned till the following year.

The Lodyguine Glow Lamps.—These new lamps, now manufactured by Cauderon, of Paris, are distinguished, says the *Bulletin International de l'Electricité*, from the Swan, Maxim, Edison, and other former lamps by their higher yield, as they produce the same luminous intensity with an expenditure of force three times less. By their means the electric light will completely vanquish gas from an economical point of view. Time must show whether the duration of the lamps will be as long as a certain part of the public seems to demand. It is, however, as Mr. Preece has shown, a mistake to insist too much on the long duration of lamps, since after 200—300 hours of service they yield little more than half their original luminous intensity.

A Destructive Thunderstorm.—A Halifax correspondent gives an account of a severe thunderstorm which recently passed over that town, occasioning great havoc and devastation. The morning was fine, but during the afternoon a great change occurred in the weather, culminating in a heavy downfall of rain, accompanied by vivid lightning and loud peals of thunder. Several houses were struck by the lightning. Chimneys were precipitated into the streets below, roofs were opened out, and water hydrants were completely twisted out of shape; paving stones were torn up, and, in some places, deep gullies were made in the road. The wires connected with the fire alarm system were also extensively damaged, but fortunately no one was injured.

Electricity in the Royal Navy.—The Admiralty has informed the Admiral Superintendent at Chatham that it has entered into a contract for supplying three sets of dynamos and engines for the turret ship *Benbow*, now building at the Thames Ironworks, Blackwall, and for the *Hero*, in course of construction at Chatham dockyard. Trials of dynamos on board the *Landrail* at Devonport last week proved satisfactory. They were carried out under the supervision of Mr. A. Richards, from the Admiralty, and Mr. Lane, electrician, of Portsmouth dockyard. The electric lighting apparatus on board the *Edinburgh* at Portsmouth has also been tested with an equally successful result.

Photographic Apparatus.—Messrs. H. and E. J. Dale, of 26, Ludgate Hill, have just issued a new illustrated descriptive price list of their photographic apparatus, materials, and chemicals. As they point out, the art of photography is most useful for the man of business, the engineer, and the surveyor, there being nothing which can give so correct an idea as a photograph of a building, machine, or article of trade, or which is so calculated to lead to business with distant correspondents. The list includes a description of the patent multiplex camera back, an invention which promises, according to the *Photographic News*, "to be of considerable practical utility to the dry plate worker."

Glow Lamps.—Dr. Julius Maier is the author of a series of articles appearing in *Industries* upon "The Construction, Efficiency, and Life of Glow Lamps." He lays it down that the glow lamp, in consequence of the simplicity of its construction, the chief cause of its practical usefulness, allows of differences only :—1. In the choice of the raw material from which the carbon filament is made. 2. In the treatment of the raw material before and after its carbonisation. 3. In the length of the filament and its cross section. 4. In the mode of connection of the filament with the current conductors, or the platinum wires respectively, which join it to the leads. 5. In the more or less perfect exhaustion of the lamp bulbs. To the consideration of these different points he devotes himself, with the wish to arrive at a conclusion, not that one type of existing lamp is superior to another, but as to what are the conditions to be fulfilled in order to obtain an efficient glow lamp of good durability.

Honours to Electricians.—French exchanges inform us that two electricians, M. Eugene Sartiaux, chief of the telegraphic service of the Northern of France railway, and M. Henri Vivarez, mining engineer, have been nominated Chevaliers of the Legion of Honour.

Queer Faults.—The experience of telegraph operators, inspectors, and linemen brings them into close acquaintance with all sorts and conditions of faults in connection with their work; the variety of these faults is wonderful, many stranger than fiction. One of the most curious in connection with telephony which we (*Mechanical World*) have ever known has just happened within the last few days at a place called Moss Bay. The lineman's attention was called to the circuit in question as hearing was difficult; on listening at the telephone he heard a "sort of booming which came on intermittently, very much resembling the distant roll of the tide, and which rendered speaking and transmission of work almost impracticable." Having satisfied himself by the usual methods that the instrument was right and the line free from induction, and that it was not picking up vibrations, the conclusion was arrived at that the fault must be in the General Office, Moss Bay. An examination of the telephone apparatus disclosed a novelty. A huge "bee" was inside the telephone, and, in trying to make good its escape, it had become fixed between the sounding board and the microphone, and it had hummed to the extent of interfering with the human organs on that circuit. How the bee came there the lineman cannot say, whether by accident or design he knows not, but the bee was the cause of the fault. In concluding his report the lineman candidly states: "I have met some very tedious and technical faults in connection with various telephone apparatus, but I never was done with a bee before."

Royal Society.—It will be remembered that in the early days of electric lighting an installation was fixed at Burlington House, but the use of the apparatus was for the time abandoned, it has now, however, been decided to reinstate the electric light, making use of a direct current dynamo instead of the alternating system previously employed, together with a set of E.P.S. accumulators. The order for the necessary alterations has been given to the Electrical Power Storage Company.

Primary Batteries.—We have received the following communication from Mr. Radcliffe Ward, too late, however, for our correspondence columns :—"Since my previous letter on the subject I have seen the Upward battery. I saw what I expected, that a number of details which are the key of all practical successes had been worked out. I do not yet know enough of the battery to have an opinion on it as a whole, taking price and working cost into consideration. But I have seen enough to say that Mr. Walker's objections generally won't hold water. Because there is complication in arrangement and construction, it does not follow that there will be in working. A man might say that a gas meter is too complicated (the readings generally are) because it had wheels and fans and all kinds of odd devices in it. But to take a better example, the Westinghouse brake is complicated in construction, but automatic, simple, and reliable in action. At present electric light is not being supplied to people who keep "slaveys," and, by and bye, very soon no doubt, even they will be able to manipulate it. After all it is not made more difficult than tapping a beer barrel and manipulating the vent peg. But I believe that close examination will show that the Upward battery is within the range of an intelligent servant's faculties. Mr. Walker mentions in his last letter filling and emptying arrangements. Mr. O. C. D. Ross, M.I.C.E., worked this out some years ago. I think the credit of that belongs to him. There is one West-end house where his battery (Ross's) is a great success I believe. The working cost of his battery is low too. There is no doubt a good deal being done in primary batteries just now; the Standard

Electric Light Company, under Mr. Stanley Currie's direction, seems to have done a good deal also to make a complete lighting plant. The important points for general application are cost, prime, and working. I expect to be in possession of facts relating to the Volta Pavia battery before long that will be of great interest in this discussion. I have seen a battery under this system run 240 hours with very slight falling off in E.M.F. There was only one charge of *the solution*, though the zinc cell solution was renewed three times during the run. This was a genuine run, I am sure, although I did not stop with it; the key was kept by a well-known man whose name would be sufficient guarantee. The battery that is moderate in price and working cost and that goes a long time without attention is the best for ordinary house work. A great deal depends, so far as the commercial purposes of the proprietors go, and the popularity of the battery, on the way the work is organised."

Judges and Patents.—Mr. Imray has written to *The Times* in reply to Prof. Silvanus Thompson's letter published in our other columns, contending that the language of Edison's telephone claim calls for the wide interpretation that has been given to it. He says: "Before the date of his patent, it was well known that diaphragms or tympans, indeed objects of all kinds, vibrate in obedience to sonorous pulses, converting variations of aerial pressure into minute mechanical movements. It was also known, but not very generally, that carbon, a substance such as Edison calls 'a semi-conductor,' when subjected to various degrees of pressure or compression, undergoes variations in its conducting power, and can therefore be made to act as what Edison calls 'an electric tension regulator.' But, until Edison showed the way, no one thought of introducing into a closed electric circuit, as part of the conductor, such a tension regulator, arranged in connection with a 'tympan or diaphragm' in such a manner that sonorous vibrations by altering the resistance of the circuit, produce electrical undulations, which acting on a distant receiving instrument, reproduce the original sounds. It is this 'combination with a diaphragm or tympan of electric tension regulators' acting in this way for this purpose that Edison claims. The idea once given, it is easy to contrive varieties of diaphragms or substitutes for them, it is easy to vary the form and construction of tension regulators, it is easy to make the combination appear very different from anything described by Edison; but, so long as 'in an instrument for transmitting electric impulses by sound' there is the combination of something that vibrates to the voice and by its vibrations acts on something which 'varies the resistance in a closed electric circuit,' that instrument is obviously within the scope of Edison's claim." Mr. Imray states in conclusion that to one rule he has strictly adhered, a rule which Prof. Thompson must, he thinks, approve—never to act as expert when he has any interest whatever in the invention litigated, or in any rival invention.

Prof. Geo. Forbes has joined in the discussion, and he asks why an assessor is never appointed to assist the court in technical trials. It is impossible, he says, to expect from judges that intimate knowledge of scientific details which will enable them always to put a right value upon the intricate technical arguments of counsel and witnesses, and for this reason it has been decreed that the court at its discretion may, and at the request of either party to a patent suit shall, appoint an assessor. He points out, however, forcible reasons why such a course has rarely been followed. Prof. Forbes also remarks upon the fact that the more wealthy of two parties engaged in electrical actions is generally found to have retained, by means of a general retainer, all the leading counsel who have distinguished themselves in electrical patent law.

Dierman's Battery.—Mr. Dierman has promised us that we may expect to be able to describe his battery very shortly, probably in our next issue.

Arc Lighting at Taunton.—Messrs. Laing, Wharton and Down have received a very gratifying testimonial as to the 30 arc light Thomson-Houston plant installed at Taunton about three months since. Mr. Massingham, the proprietor, says:—"I am pleased to say it has run during the whole of that time without a single hitch of any kind whatever, and all the customers are charmed with the light. I have in consequence decided to double the plant, and shall feel obliged by your supplying me with another 30-light machine by September 29th."

What is a Filament?—We have received an anonymous communication for our Correspondence columns under this heading, in which the different uses of the word filament is discussed, and the judgment in the recent patent action criticised. If the writer will oblige us with his name we shall be glad to publish his letter.

Electric Railroad at Minneapolis.—The Minneapolis, Lyndale, and Minnetonka Railway Company some time ago entered into a contract with the Van Depoele Electric Manufacturing Company of Chicago to bring the trains of the former into the city from the outskirts. A steam dummy brings the trains as far as permitted by the city ordinance, and then the electric motor brings them "down town" with their passengers; in less than a minute from its arrival the electric-motor is on its way back to the dummy to receive the next incoming train. The train consists of three or four passenger cars, each weighing 11 tons empty. The number of passengers carried is often as high as 600 at one time, so that the weight of a full train is something like 91 tons. The operations of the electric motor begin at six o'clock in the morning and close at half-past eleven at night. The distance over which it travels is about a mile, and its speed is 17 miles an hour, that being the regulation rate within the city limits. The electric-motor has been in operation for several weeks without a hitch or a breakage; it is of about 40 H.P. and works as perfectly under a heavy as under a light load. The generator furnishing current to the motor is driven by a 12 inch by 8 inch cylinder slide-valve engine, making 125 revolutions per minute; steam pressure 60 or 80 lbs.; consumption of coal in 18 hours' run, 3,000 lbs. Mr. C. J. Van Depoele argues from these facts that electric motors may be as well applied to elevated as to ordinary roads. He says there is no more trouble in building 200 or 300 H.P. generators than in producing machines of 50 H.P. Several of these machines can be connected up and run in perfect unison, and by uniting their currents any amount of power can be transmitted with at least as much reliability as from a steam boiler.

The Electric Lighting of Covent Garden Theatre.—Mr. W. Freeman Thomas has, we learn, placed the contract for lighting Covent Garden Theatre during the Promenade Concert Season, in the hands of Messrs. Patterson and Cooper. The lighting is to be on a scale of unusual magnificence, as 25 arc and 450 incandescent lamps will be employed, and we have no doubt from the well-known ability of the contractors that their selection for the undertaking will be fully justified. At the same time it seems a little ungracious that the claims of the Jablochkoff Company, an old and, if we may judge from the glowing testimonials presented by Mr. Thomas, valued servant, should be ignored.

Electric Locomotion in America.—According to the Boston correspondent of the New York *Electrical Review*, a bill granting a charter to the Winthrop Electric Railroad Company has been signed by the Governor, and is now a law. The car on the experimental track has been run at the rate of 35 miles an hour up a grade of 360 feet to the mile. It is expected that one mile of the Winthrop road will be in operation by September 1st. Cars are to be run from 6 a.m. till midnight, longer trips being made as fast as the track is completed.

The Maquay Battery.—The report on this battery which Mr. Sidney F. Walker has kindly forwarded for publication in our columns is too voluminous to appear in our present issue. In our next we shall endeavour to briefly analyse Mr. Walker's remarks, although we think our readers will fairly estimate their value without our assistance.

City and Guilds of London Institute.—It is intended to perpetuate the Colonial and Indian Exhibition in a permament building at South Kensington. A correspondent of the *Echo* referring to this matter says :—"A good opportunity thus arises for the City and Guilds Technical Institute to close their South Kensington College and let the building as a home for the Colindies, to which it is well adapted. As a College for Training Technical Teachers it has not been a success. Although the buildings and fittings cost nearly £100,000, and £10,000 a year is needed to carry on the work of the college, it, last year, secured the attendance of only 145 students ; and not more than 25 of these matriculated or took the whole course. Each effective student, therefore, cost the institute between £400 and £500 in that year for his technical 'education.' The choice of the site at South Kensington was a mistake to begin with, as most people knew ; but the offer of the land rent free (subject, however, to certain onerous conditions) was a temptation, and the prospect of Royal patronage was attractive. For half the money expended at South Kensington, or at any rate, for not more than £50,000, the Corporation and City Guilds could put on the Blackfriars Embankment a building much better adapted for its purpose than the present one." The result of the year's experience at the South Kensington College, as shown by the above figures, must be allowed to be deplorable, and the first impulse is to enquire as to the cause of such a result. We have heard one or two suggestions, but should not care to make public what has been only vaguely mentioned in our presence.

Incandescent Lamp Patents.—We learn that Messrs. Shippey Brothers have commenced legal proceedings against the Edison and Swan United Electric Light Company for intimidating their customers and agents against using the Shippey lamps. This firm states that it is prepared to indemnify all customers against any proceedings which the said company may take respecting lamps sold by the firm. We call attention to their special announcement in our business columns.

The Sun Distributor Box.—Tests have recently been made at the office of the Brush Electric Company, of Boston, with a Sun distributor box, in conjunction with a Sprague automatic motor. It was found that on a 3,500 volt circuit there was practically no sparking at the brushes, though the power taken from the motor was varied. The motor was run in parallel with varying numbers of incandescent lamps, and without the slightest flickering, the distributor box making adjustment for all changes. The circuit to the motor was repeatedly broken by removing a bare wire from one binding post of the motor, with no shock and as little sparking as would be noticed if the same thing were done on a 100 volt multiple arc circuit. At the termination of the experiment, a New York contemporary states, an order was given for 50 distribution boxes.

A "Quixotic" Cure. — A Spanish inventor has recently obtained a patent in this country, according to *Invention*, for converting flannel underclothing into a sort of galvanic battery, so that the wearer may be always under the influence of the current. "In a bath composed of the oxides of iron, copper, zinc, and tin, mixed in fine powder with gum water, the flannel is soaked and thus becomes charged with electrodes, which are excited by the natural perspiration, and thus gives off a weak but constant electric current, which may or may not effect a cure, according to the faith of the wearer."

An Electric Tricycle.—Mr. N. S. Possons, superintendent of the Brush Electric Company, of Cleveland, O., has caused to be constructed, and now has in successful operation, a tricycle driven by an electric motor. The current is derived from a number of Brush storage batteries enclosed in a neat box of cells under the seat. The motor is of the Brush type, and is specially made for the purpose. There is also a small Swan incandescent lamp in connection for a headlight, which can be switched on or off at will.

Too Much Light!—The Association of Dutch Gas Engineers recently met at Amsterdam. They dined in a handsome room in the Café Krasnapolsky, which was brilliantly illuminated by means of the electric light. *Gas and Water*, speaking of the lighting, says :—"The installation in this establishment is beyond all question the finest on the Continent, and there is nothing to compare with it in this country. In the main room, open for the reception of the usual customers, a flood of light equal to 25,000 candles is thrown upon the company. This light proceeds from five arc lamps and from two huge clusters of glow lamps in the centre, as well as from semi-circles of similar lamps along the gallery and at the end of the hall. Other parts of the establishment are also effectively lit by this system ; but it is rather astonishing that the proprietors should not have extended it to the adjoining hotel. In the restaurant they evidently find that the electric light has powerful attractions, and for this purpose alone we suppose it has been introduced ; but the lavish expenditure of light appears to us to be out of all proportion to the requirements of the place."

Branding Sheep by Electricity. — The Chemical Electric Light and Power Company, of Boston, has received an order for the Volta-Pavia battery to be put to a new and unique use. The proprietor of an extensive sheep ranch in Montana intends using the battery for maintaining a platinum wire at a white heat, which will be used for branding the members of his flock on the nose. The operation is quickly performed, and comparatively painless, when the former plan of using the clumsy branding iron is considered.

Todmorden and Electric Lighting. — About two months ago, the *Gas World* says, it chronicled the interesting fact that the Todmorden Local Board annually appointed an electric lighting committee, and, after doing so, considered its duty to the electric light accomplished until the next annual meeting. The committee never met, and never presented a report. Our contemporary has now to qualify this statement to bring it into accordance with present circumstances. The electric lighting committee appointed last April has held a meeting, and has actually transacted some business. It selected its chairman, instructed the surveyor to write to various towns where the electric light has been discontinued, and also to towns where it is now in use, for information ; and, further, instructions were given that the "Victoria Lighting Company" should be asked to favour the committee with information as to its mode of lighting. We may expect an interesting report from the Todmorden electric lighting committee by and by.

Personal.—Mr. Hugh Watt, M.P., who is chairman and managing director of the Maxim-Weston Electric Company, has just had conferred upon him, by the president, the Grand Cross of the Order of Simon Bolivar, for distinguished commercial services in connection with the United States of Venezuela.

Atlantic Cable Rates.—The directors of the Anglo-American Telegraph Company (whose report will be found in our City columns) show no signs of any desire to put a stop to the cable war of rates. If Lord Monck speaks as a plain man of business, says the *Financial News*, and not as a diplomatist by whom language is only employed to conceal the thought,

there is the prospect of the public enjoying for a long time to come the benefit of cheap rates. According to the chairman of the Anglo Company, "The unexpected increase in the volume of traffic immediately upon the introduction of the sixpenny tariff has induced the directors to consider the expediency of adopting permanently a system of low rates. The associated companies possess among them no less than eight cables across the Atlantic, having a carrying capacity which for practical purposes is unlimited. With such an extensive system, it is obviously their interest to encourage a very large traffic at low rates, and by so doing prevent a further multiplication of unnecessary cables." These are brave words—just the words that a bold man engaged in a struggle *a l'outrance* might employ; but they contrast strangely with previous utterances from the same mouth. A year ago Lord Monck said in the Anglo report: "The reduction of tariff to 1s. 8d. per word—commenced on December 24th, 1884, in consequence of the opening of the Commercial Cable Company—still continues in force; the result is that none of the companies engaged in carrying telegraph traffic across the Atlantic are earning any substantial dividend." This half year the Anglo Company, with its inflated capital, pays no dividend at all. But there is a suddenness about the conversion of Lord Monck to the merits of a low tariff which is rather extraordinary. It was generally understood by the world at large that 6d. a word was a "fighting rate"—that it was adopted as a means of compelling the Commercial Cable Company to accede to a 2s. or 2s. 6d. rate; and now the chairman of the Anglo comes out with the declaration that low rates are to be given a fair trial and to be permanent. Good and well. Low rates are of advantage to everybody who uses the Atlantic cables, and may, in the long run, benefit cable shareholders; but a sixpenny rate is too low. It is less than the public asks; it is less than should be asked. A shilling rate would satisfy everybody, and on this basis a large business would ensue. Meanwhile, with Lord Monck's assurance that the associated cables have an unlimited carrying capacity, he will find it difficult hereafter, if he again changes his mind, to exact the high rates for which the monopoly companies have for months past been contending.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Colchester Electric Light and Power Company, Limited.—The registered office of this company is at 5, North Hill, Colchester.

Loeb Chemical Electric Light Company, Limited.—An agreement, dated 18th ult., between the company and Leon Napoleon Loeb, of Church Alley, Basinghall Street, confirms an agreement of 20th of May, and provides for the allotment to Mr. Loeb of 3,000 fully paid shares of £1 each in pursuance of such agreement. Mr. Loeb may not (except by will or codicil) transfer or otherwise dispose of more than 1,000 of these shares for a period of 12 months from the date of this agreement, and after the expiration of such period he may not dispose of more than 200 of the remainder of such shares in any one year.

CITY NOTES, REPORTS, MEETINGS, &c.

Eastern Telegraph Company, Limited.

The twenty-eighth half-yearly general meeting of this Company was held at Winchester House, Old Broad Street, on Thursday, the 15th inst., under the presidency of Mr. John Pender.

Mr. George Draper, the secretary, having read the notice convening the meeting,

The Chairman said: Before moving the resolution asking you to approve of the report, I will as usual give some particulars of the half-year's working. The revenue for the six months ending March 31st, 1886, amounted to £341,405, against £371,682 in the corresponding period of the previous year, a decrease of £30,277. It will be observed in reference to the accounts, that there is a decrease in the returns on the investment in the South African Company of £1,950 owing to diminished receipts; that company has only been able to pay 6 per cent. instead of 7 per cent. as in the previous year. The Indian traffic is fairly maintained, but the traffic to countries beyond India has declined since December last. The chief cause of our decreased receipts, as we believe, arises from the absence in the last half year of political and other events, which in the year 1885 augmented our Indian and Egyptian traffic to an exceptional extent. The total working expenses amounted to £92,244, against £91,599 in the corresponding period of 1885, being an increase of £645. But in this half year are included several items of an exceptional character, such as expenses of removing into new offices, expenses relating to negotiations in France, Germany, and Egypt, the protection of submarine cables, making a total of £1,566. There is also charged to revenue account an amount of £788 the cost of duplexing the Zante-Alexandria cable, so that after deducting these exceptional sources of expenditure the accounts show a considerable decrease. General expenses in London were £8,773, against £7,617, an increase of £1,156. The principal increases in these expenses were rent and taxes, repairs and renewals of furniture, and are mainly due to our having removed to larger and more commodious offices, which were found absolutely necessary. Salaries and wages, stationery and printing, and law charges, show decreases amounting in the aggregate to £176. Working expenses at stations amounted to £64,439, against £66,582 in the corresponding period, or a decrease of £2,143. With reference to the items shown separately in the revenue account, use of patents shows a decrease of £1,600; amount written off for depreciation of cable stores, £4,200. We have carried £5,000 to the maintenance of ships reserve fund, against £6,000 in the corresponding period of 1885; expenses attending the repairs and renewals and the landing of cables amount to £41,637, against £44,815, or a decrease of £3,178. It will be seen on reference to Abstract C that full details of work done by our ships are given. Numerous and important repairs have been effected, and in addition the *Volta* steamship has renewed the new three-coiled cables across the Straits of Messina, the cost of which is taken from revenue; but a large part of this sum is due to the sudden breaking of both of our Bombay cables in 800 fathoms of water during a cyclone. Those cables are now repaired and in working order. After charging all expenses, including income tax, we are enabled to pay a dividend of 5 per cent. and 1 per cent. bonus, or at the rate of 6 per cent. per annum, and to carry to general reserve fund £70,000, leaving a balance of £4,079 to be carried forward to the next account. I think, gentlemen, that you will agree with me that that as a whole is a very satisfactory account to lay before you. We are making a new departure in regard to rates, arising from the conference which was held last year at Berlin. On all sides we hear, "Only reduce the rates and you will have a largely increased revenue." We are very anxious to reduce the rates, but we think the risk ought not to be entirely with the company. What we are trying to establish, in Australia and other parts, is, if you will guarantee us such returns as we have been enjoying for the last three years, you may make the rate pretty much what you please. In other words, we are endeavouring to establish a rate which shall practically be a guaranteed rate for the proprietors of this company, and at the same time an enormous advantage to the different governments, and to the telegraphing public, by which means rates might be reduced to an extent simply impossible for the companies without a guarantee. Negotiations are going on with Australia at the present time, and although looked upon with some little shyness, I think that those who represent the Colonies and those who are looking carefully into the question are satisfied that this must eventually be the solution of the question of reduction of rates, and when that occurs you will practically be enjoying, as proprietors of this company, a guaranteed rate of interest upon your shares. I refer to this because it is very much occupying the thought and time of your directors at the present time, and I am hopeful that these negotiations will make such progress as by-and-bye will be beneficial indeed to the company. I see frequently calculations made as to our property; but there is one thing you may rest perfectly satisfied of—that telegraphy must grow. Politics demand it, commerce demands it. Talk of declining telegraphy is all nonsense. Human nature is in accord and harmony with telegraphy, and, depend upon it, it will grow, it must grow; as nations grow, so will telegraphy grow. And therefore I have no fear of those who are making calculations that we are going back and that our stock must be reduced in value—I have no sympathy with them at all. Depend upon it, as long as telegraphy has the hold which it has at the present time upon the public generally there is no great fear of its going to the bad, unless unnecessary and undue competition arises, and that is a question which we take as much care as possible to avoid. At the Berlin Conference a question arose about Egypt, and in the spring I went out to Egypt, saw the Government there, and I am pleased to say that the arrangement by which a considerable annual payment was to have been made to the Government by the company was entirely set aside, so that we are precisely in the same position to-day that we were before we went to Berlin, and we consider our position a very strong one, so that if that question again arises we shall be in a position to get something as well as to give. Visits to the stations abroad are calculated to do good in many ways. All our stations are in the most perfect working

order. A visit to them occasionally gives encouragement to the young men, and I found, comparing our stations with those of other companies, that we have every reason, as Englishmen, to be proud of them. We have just received intelligence that a company with which we are in very close alliance, the African Direct Company, has received a congratulatory message from the Governor of Sierra Leone upon the opening of the station there. Probably after a few weeks that system will be completed and it will then become a feeder for our lines from Lisbon. Therefore, as far as I can see at present, we are in a very satisfactory position. When the question of this West African concession came before the Government there were some remarks made by a gentleman who was interested in an opposition company, who desired a competing company to Australia. He admitted if this West African concession was passed it would be a death-blow to his scheme. That scheme, I think, was of such a nature as was perfectly uncalled for and unnecessary. I was very glad to find our concession approved of, and it ought to have been, because no bargain was ever made with the Government in so straightforward a manner and so much in the interests of the public generally. It was passed through the hands of three different English Governments and checked in every possible way, and it was gratifying to find that the Secretaries of the Treasury of those respective Governments defended that concession in the House in a way which must have been very unsatisfactory to those who challenged it, but very satisfactory to those interested in it. With these remarks I beg to move that the printed report of the directors to March 31st, 1886, together with the statement of accounts submitted to this meeting be, and the same are hereby received and adopted; that a dividend on the preference shares of the company at the rate of 6 per cent. per annum be paid, less income-tax; and that, in accordance with the directors' recommendation, a dividend be and is hereby now declared of 2s. 6d. per share with a bonus of 1s. per share, both free of income-tax, on the ordinary shares of the company, making with previous payments a total dividend of 6 per cent for the year.

The Marquis of Tweeddale seconded the motion, which was carried unanimously.

Mr. Newton, in moving a vote of thanks to the chairman, said that the manner in which Governments were dealing with the property of shareholders was scarcely fair to the latter, and he thought the directors of this company had protected their interests as well as had been possible under the circumstances.

The vote was carried with acclamation.

The Chairman, in responding, said the directors took great pride in the progress and possibilities of this company, but they had a great deal to contend against. As he had said, telegraphy was growing, but everybody seemed to think it ought to be much cheaper, and therefore, whilst they were protecting the shareholders' interests, they were also most anxious to give as much impetus to telegraphy as they could, by reducing the rates.

Anglo-American Telegraph Company, Limited.

THE report of the directors states that the total receipts from the 1st January to the 30th June, 1886, including a balance of £4,096 13s. 7d. brought forward from the last account, amount to £116,737 11s. 9d. The traffic receipts show a decrease as compared with the corresponding period of last year of £22,321 consequent upon competition, a reduced tariff, and continued depression of trade between Europe and America.

The total expenses of the half year, including repair of cables, &c., as shown by the revenue account, amount to £46,813 12s. 7d.

The directors, under the powers conferred upon them by the Articles of Association, have, before declaring the net profits, set apart the sum of £50,000 to the renewal fund, leaving a balance of £19,923 19s. 2d.

One quarterly interim dividend of 5s. per cent. on the ordinary stock, and of 10s. per cent. on the preferred stock, was paid on the 1st May, 1886, absorbing £17,500. It is not proposed to declare any interim dividend for the past quarter, but to carry the balance of £2,423 19d. 2d. forward to the next account.

The company's repairing ss. *Minia* has been engaged during the past half-year in the repair of the Northern Placentia and Duxbury cables, and also of the Direct United States Cable Company's short section cable between Torbay and Rye Beach.

The whole of the company's cables and land lines are in good working order, with the exception of the Duxbury cable, which was again broken on the 2nd inst.

In the month of May last a conference was summoned by the French Government and held at Paris, at which the principal European and American States were represented, for the purpose of reconsidering the clauses of the Convention of 1884, for the protection of submarine cables, which had been modified at the instance of the English cable companies by the Act of Parliament passed in 1885.

A committee was appointed by the conference to examine the details of the modifications, and to hear the views of the telegraph companies on the subject. The delegates of the companies (including the managing director of this company) attended the committee, and, after much discussion, the conference adopted declarations which fairly satisfied the requirements of the cable companies.

The reduction of tariff from 2s. to 1s. 8d. per word, introduced by the Commercial Cable Company (Mackay-Bennett cables) on the 24th December, 1884, resulted in a large decrease in the gross revenue produced by Atlantic cable traffic. Nevertheless, it was determined by the associated cable companies to give the reduced tariff a fair trial, in order to avoid a war of rates, and to determine as early as possible whether the reduction would result in any remunerative increase of traffic.

After more than a year's trial it was found that the very contrary was the case, and as the rival company resorted to means to obtain a greater share of the traffic than the possession of two cables fairly entitled them to, the directors of the associated companies came to the conclusion that it was necessary in the interests of their proprietors to adopt a low rate.

Accordingly on the 5th May, 1886, the rate was reduced by the associated cable companies to 6d. per word, and by special arrangement with the Western Union Telegraph Company of America, this tariff was made to extend to all the principal cities and towns in the United States and Canada. For Press news a special rate of 3d. per word between London and New York was also adopted. On the same date the tariff of the Mackay-Bennett cables was reduced to 1s. per word.

The effect of this important reduction of rates by the associated companies has been a very considerable augmentation of the traffic, much larger, indeed, than was anticipated as a first result, amounting to over 110 per cent., and although the total receipts have greatly decreased, the company is earning sufficient to pay its working expenses, and to place such a sum to the credit of the renewal fund as with the accruing interest will soon bring that fund up to £1,000,000, the limit fixed by the proprietors at the last half-yearly meeting.

The unexpected increase in the volume of traffic immediately upon the introduction of the sixpenny tariff, has induced the directors to consider the expediency of adopting permanently a system of low rates. The associated companies possess between them no less than eight cables across the Atlantic, having a carrying capacity which for practical purposes is unlimited. With such an extensive system, it is obviously their interest to encourage a very large traffic at low rates, and by so doing prevent a further multiplication of unnecessary cables.

By the recent reduction of rates, cable customers and the public have the opportunity of answering the question upon which the future rate between Europe and America will have to be decided, namely, whether there is a sufficient inherent development in the cable traffic to and from America, to warrant a low charge being permanently established. If there be such development, and the public respond to the desire of the associated companies to continue working at low rates, it will be to the interest of the companies to do so, as they only desire to earn a reasonable return upon the capital invested and prevent further wasteful competition.

The directors would remind the proprietors that the company has now been in existence for over 20 years, and that although high rates were, in the first years of the undertaking, an absolute necessity, and were not at that time objected to by any important class of the community, they have since been found, whenever adopted, to produce continuous competition, useless multiplication of cables and loss of money to all the companies interested.

The directors believe that sooner or later a low tariff will be a necessity, and that by "taking time by the forelock" and making an earnest effort now to establish it, they will secure the cordial approval and co-operation of their customers and the public, without which so important a step could never be successfully adopted.

India Rubber, Gutta Percha, and Telegraph Works Company, Limited.

THE half-yearly meeting of this company was held at the Cannon Street Hotel on Tuesday for the purpose of considering the directors' recommendation for the payment of an interim divided of 5 per cent. Mr. S. W. Silver presided.

Mr. W. J. Tyler, the secretary, having read the notice convening the meeting,

The Chairman said: Well, gentlemen, the notice conveys the object of our meeting to-day, and as our books are made up but once a year we have no accounts to present to you. The general report I have to make to you is that business is, considering the generally depressed state of trade, fairly good. Our works are in excellent condition and order, both in England and in France. Our steamers are fully occupied; and without detaining you further, few as these remarks are, I will move that an interim dividend of 5 per cent., less income tax, be paid.

Mr. Neil Bannatyne seconded the motion, which was unanimously agreed to.

The Chairman: Now I believe our object in meeting is accomplished.

Mr. Cater: Mr. Chairman, I beg to give notice that at the next general meeting of this company I shall bring forward for the consideration of the shareholders the large amount which you set aside for the remuneration of the directors. At the last general meeting that was upwards of £1,100 apiece, and the sum has been increased by the augmentation of the direction since that time.

The Chairman: You are in error there. There has been no increase.

Mr. Cater: I am very glad to hear it. The next balance-sheet will show us what the amount is.

Dr. Small moved a vote of thanks to the chairman and directors for the continued success which attended the company. He recently went to Silvertown and saw the works, and was very much pleased with what he saw; he believed the cables turned out

by the India Rubber Company to be as good as any cables manufactured by other companies.

The motion was seconded and carried, and was acknowledged by the chairman.

Mr. Paine asked what remuneration the directors received per annum.

The Chairman replied that the minimum for the whole board was £2,000 and the maximum £5,000.

This terminated the meeting.

Telegraph Construction and Maintenance Company, Limited.

THE half-yearly general meeting of this company was held at the offices, 38, Old Broad Street, on Tuesday, under the presidency of Sir Daniel Gooch.

Mr. William Shuter, the manager, having read the notice conveneing the meeting,

The Chairman said: These meetings, as you are aware, are not called for the purpose of presenting accounts to you, but to give a short statement of the work done during the past half year. During that period a cable has been laid, 398 miles in length, between Penang and Singapore, to replace an old cable which was picked up. We have also laid 1,130 miles along the West Coast of Africa; when completed that cable will embrace a length of about 2000 miles, and will connect the African settlements from Bathurst to the River Niger. We have manufactured during the year about 2,100 miles of cables. I may say that the prospects for the next half year are not so flourishing as those of the last, but me must trust to fortune to get more work to do. With regard to the electric lighting, that has been in operation for three months, but legal difficulties have been raised with regard to the noise and annoyance by some of the residents in houses adjoining the works, and as the matter is still under litigation I am not able to go into the matter, and must leave it till the next half-yearly meeting.

Mr. Holdsworthy: You say there is litigation. Is the light still going on, or has litigation stopped the actual working?

The Chairman: The lighting is going on, and is very perfect. The only question is whether we can produce it without annoyance to our neighbours.

Mr. Gibson moved a vote of thanks to the Chairman, which was accorded, and the meeting was brought to a close.

Stock Exchange.—Application has been made to the Stock Exchange Committee for appointment of a settling day and quotation for the £250,000 4 per cent. mortgage debentures of the African Direct Telegraph Company, and the £75,000 five per cent. mortgage debentures of the Brazilian Submarine Telegraph Company.

The Western Counties and South Wales Telephone Company, Limited.—This company has declared an interim dividend on its preference shares of 3 per cent. for the half year ending the 30th June last (*i.e.* at the rate of 6 per cent. per annum), payable at the company's banker's on and after Monday the 19th inst.

Globe Telegraph and Trust Company, Limited.—The directors have declared a final dividend, payable on and after the 29th inst., of 3s. per share on the preference shares, less income tax, and of 2s. 9d. per share on the ordinary shares (income tax having already been deducted) for the year ending July 18th.

The Eastern Extension, Australasia and China Telegraph Company, Limited.—The directors announce that the coupon on the 6 per Cent. debentures, due on August 1st, will be paid after that date at the Consolidated Bank, 52, Threadneedle Street, E.C. Coupons must be left three days for examination.

Anglo-American Telegraph Company, Limited.—The directors have resolved to place the sum of £25,000 to the credit of the renewal fund for the quarter ending 30th June, 1886, and to carry forward the balance of revenue account amounting to £2,400.

Submarine Telegraph Company, Limited. — The directors, after adding 15 per cent. of the gross receipts to the reserve fund, recommend a dividend at the rate of 12 per cent. per annum for the half year ending June 30th.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 16th were £2,209, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th July are £2,681, as compared with £2,554 in the corresponding period of 1885.

The Brazilian Submarine Telegraph Co any Limited. The receipts for the week ending July 16th were £2,790.

NEW PATENTS—1886.

9214. "Making and coating or covering various metal wares by combined electro-chemical and mechanical process." F. [F. E.] ELMORE. Dated July 15.

9215. "Applying electricity to vehicles on tram and railways, and apparatus for effecting the same." F. WYNNE. Dated July 15.

9228. "Apparatus for generating electricity by means of heat." W. BRAKEFIELD. Dated July 15.

9229. "Incandescent electric lamps, and preparing and carbonising the conductors of such lamps." P. WARD. Dated July 15.

9230. "Chair with electrical appliance adapted thereto for medical and other purposes." F. SHARPE. Dated July 15.

9277. "Electrical apparatus for use in transmitting and repeating or checking instructions on board ships." H. P. SHERLOCK. Dated July 16.

9310. "Giving or producing electric shocks." N. W. RUSS. Dated July 17.

9326. "Morse inker apparatus for telegraphic purposes." C. D. ABEL. (Communicated by Siemens and Halske.) Dated July 17.

9354. "Secondary batteries." W. H. AKESTER. Dated July 19.

9399. "Administering Faradic or galvanic electricity combined with an advertising apparatus." W. OLIVER. Dated July 20.

9403. "Galvanic batteries." A. J. BOULT. (Communicated by O. Lugo.) Dated July 20. (*Complete.*)

9432. "Treating auriferous substances by electrolysis." H. LIEPMANN. Dated July 20.

9459. "Dynamo-electric motors and controlling and regulating same and differential gearing applied to same." F. WYNNE. Dated July 21.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1885.

7074. "Improvements in electric arc lamps." F. L. MUIRHEAD. Dated June 10. 6d. In a lamp made according to this invention one, or in some cases both of the electrodes, is constructed of carbon of hollow, cylindrical, or other shape, so that a core of some refractory material, such as kaolin, steatite, &c., or marble, can be introduced and be allowed to project into the arc between the two electrodes to the desired extent, thus keeping separate one electrode from the other. Claim:—The method of regulating the "arc" in electric lamps by means of adjustable core pieces of refractory material substantially as described.

7573. "Improvements in the method of illuminating by means of the incandescence of refractory substances." O. FAHNEHJELM. Dated June 22. 11d. Consists of improvements on the system of incandescent lighting by means of refractory bodies, for which Letters Patent were granted, No. 5646 of 1883. Claims:—1. The described method of constructing the incandescence bodies, consisting in the insertion of needle-shaped pieces with projecting heads of round polygonal, or other suitable section, loosely into a correspondingly perforated holder, consisting of a plate of metal, porcelain, clay, or other refractory material. 2. The combination of parts consisting of rods with a holder of the incandescence piece and sockets on fixed or movable arms, for the object of easy detachment and adjustment, substantially as described. 3. The method of suspending the incandescent pieces from a ring carried either by the lamp globe or lamp glass, substantially as described. 4. In circular burners, or burners with two or more flames, the use of annular, disc shaped, star shaped, or otherwise formed plates for holding the incandescent pieces, or the use of polygonal, annular, or star-shaped frames, for connecting several simple incandescent pieces into a composite one of the requisite form, substantially as described. 5. The method of supporting the composite incandescent body by means of a central rod, which when used with round or star-shaped burners, is fixed in the middle of the burner, substantially as described. 6. The construction of the incandescent bodies with thickened ends, which fit into the supporting discs or bearers through suitable perforations. 7. The method of securing the incandescent bodies in a refractory mass, borne by a metal piece, substantially as described. 8. The method of packing the incandescent pieces for transport, substantially as described.

7869. "Improvements in incandescence electric lamps." H. WATT. (Communicated from abroad by E. Weston, of America.) Dated June 29. 8d. Claims:—1. In an incandescence electric lamp, the use of leading-in wires or conductors having eyes formed by bending the wire back upon itself and uniting the two parts thereof, substantially as, and for the purpose, set forth. 2. In an incandescence electric lamp, the combination, with leading-in wires or conductors having eyes formed by bending the wire back upon itself and uniting the two parts thereof by twisting or otherwise, of a vitreous seal surrounding the said wires or conductors, and wholly or partially covering the twisted or united portions thereof, substantially as set forth. 3. The improved incandescence electric lamp, constructed substantially as described with reference to the drawing.

8703. "An improved device for straining and fastening guy ropes or wire stays of telegraph posts." D. SINCLAIR. Dated July 18. 6d. Claim:—A straining and fastening device for guy ropes or wire stays of telegraph posts consisting of a shackel or bifurcated bracket and a winding barrel carried thereby and provided with means for turning the same and for retaining it against the strain of the guy or stay, substantially as set forth.

8743. "A new or improved combination of telephonic apparatus and electric bells." J. H. JOHNSON. (Communicated from abroad by La Société P. Barbier and Cie., of Paris.) Dated July 20. 8d. Claims:—1. The combination with the case of the push button of an electric bell of a telephonic apparatus substantially as, and for the purpose, described and illustrated. 2. The combination of a telephone system and an ordinary electric bell or call system in one and the same apparatus substantially in the manner and for the purpose described and illustrated.

8987. "A galvanic plant invigorator and oxygeniser." R. G. OWEN. Dated July 25. 8d. In the earth of the pot the inventor inserts two plates or plugs, forming the poles of a battery at a short distance from one another, as, for instance, at opposite sides of the plant, but connected by a conducting wire. Claim: The employment of an electric or galvanic current for the purpose of oxygenising and invigorating plants or seeds as herein explained and set forth.

9029. "Improvements in electrical arc lamps." A. F. LINK. (Communicated from abroad by L. Scharnweber, of Kiel.) Dated July 27. 8d. Claims:—1. The application and use of carbon holder points, for governing the position of the carbons in electric arc lamps, such points being manufactured from platinum metal or its alloys or from phosphoridium, substantially as described, and shown on the drawings. 2. The method of insulating the carbon holder points, for the purposes aforesaid, by means of fire proof cement or a socket filled with a fire proof mineral, substantially as before described and shown in the drawings. 3. The application and use of carbon holder points for the purposes aforesaid, manufactured from fire proof non-conducting minerals, such as silicates, chromo-oxide, aluminium-oxide, or their combinations, substantially as described. 4. The application and use of carbon holder points, for the purposes aforesaid, consisting of a grain of osmium-iridium, enclosed or mounted in a piece of platinum, or platinum-iridium, the latter being mounted in copper or brass, substantially as described. 5. The application and use, in electric arc lamps, of the automatic disconnecting apparatus, whereby the disconnection takes place when the carbon is consumed; actuated by a weight or spring, substantially as described and shown in the drawings. 6. The application and use, in electric arc lamps, of the automatic disconnecting apparatus, substantially as herein before described and shown in the drawings. 7. The application and use, in electric arc lamps, of the method of regulating the relative positions of the carbons by means of the springs, *f*, *f*, and rollers, *r*, *r*, substantially as herein before described and shown in the drawings. 8. The application and use, in electric arc lamps, of the method of regulating the relative positions of the carbons, by means of the arrangement substantially as herein before described and shown in the drawings. 9. The general construction, combination and arrangement of the several and respective parts, together forming the improvements in electric arc lamps, substantially as described and shown on the drawings.

9108. "An electric air pump." S. C. C. CURRIE and I. A. TIMMIS. Dated July 29. 8d. Claim:—The compression of air by means of successive strokes of the centre rod of a magnet acting as or acting in conjunction with a piston as described.

CORRESPONDENCE.

More Plums from the Law Courts.

Herewith I beg to present you with a few additional plums:—

1. Because in Hughes's microphone there are blocks of carbon and suspended pencils of carbon, and because in Bassano's transmitter there are blocks of carbon and suspended pencils of carbon, therefore Bassano's transmitter is a form of Edison's tension regulator. (*Vide* judgment of Lord Justice Cotton and two other appeal judges.)

2. It is no part of the business of a Court to decide what details of difference constitute an infringement! (*Ibid.*)

3. Because, according to Lord Justice Fry, a diaphragm or tympan, as specified by Edison, must not only be a true tympanum—"like a drum"—but must also be capable of entering into vibration when spoken to, therefore anything capable of entering into vibration when spoken to, whether like a drum or not, is a diaphragm or tympanum. (*Vide* Mr. Justice Sterling's judgment.)

4. A zinc ball in a transmitter will not talk, *therefore* Reis's instrument in which there were platinum contacts will not talk. (*Ibid.*)

5. Reis's transmitter (having gravity contacts) is admittedly not within Edison's specification in which contacts are kept together by a spring. But gravity is a mere mechanical equivalent for a spring. Therefore St. George's transmitter, which has gravity contacts, infringes Edison. (*Ibid.*)

6. Resiliency—that blessed word (which, by the way, Edison never used. Isn't it merely the same thing as elasticity or springiness, writ large?)—is an essential feature of Edison's patent. Carbon, as used by St. George, possesses resiliency. (No one ever heard of platinum being springy, of course. Query, is lampblack springy?) Therefore St. George's transmitter infringes Edison's patent. (*Ibid.*)

7. When one thing rolls over another they are always in contact—there are no hops (however rough the material). This proves that St. George's transmitter worked in a circuit that was, as Edison said, always closed. (*Ibid.*)

l'Homme Qui Rit.

Lippmann's Current Meter.

I should be very much obliged if you, through your correspondence columns, would inform me where to get the Lippmann's current meter mentioned in your esteemed journal of February 21st, last year.

E. S.

Kjobenhavn,
14th *July*, 1886.

[The apparatus is constructed by, and may be obtained from, Breguet, 39, Quai de l'Horloge, Paris.—EDS. ELEC. REV.]

Work Performed in Telegraphing.

In reply to "Ita"—The constant 1·355 is the number of foot-pounds in a watt; and since a watt is equal to a (volt × ampère × second), therefore a foot-pound is equal to $\frac{\text{volt} \times \text{ampère} \times \text{second}}{1{\cdot}355}$. But the milliampère is used in telegraphy instead of the ampère, so that the formula becomes $\frac{E\,c\,t}{1{,}355}$ equals work done in foot-pounds.

I observe that through a slip of memory I have made a slight error in the constant, which should be 1,355 instead of 1,325.

W. Moon.

The Clerk Gas Engine.

In your article on "Monopolists and Private Users," of last week, I observe that you refer to my gas engine in a manner which conveys an erroneous impression to the public of the nature of the compromise effected between the engineers who manufactured it, Messrs. L. Sterne and Company, and Mr. Otto.

The Clerk gas engine continues to be manufactured and sold as heretofore by Messrs. Sterne and Company, and no purchaser either past or present is in the smallest danger of annoyance from Mr. Otto. The case of Otto *v.* Sterne was compromised without being fought at all, and on such a basis that Messrs. Sterne and Company still continue manufacturing and selling my engine. Mr. Otto found it convenient at the last moment to settle with Messrs. Sterne and Company and avoid litigation with them; and Messrs. Sterne and Company being offered terms which in their opinion did not interfere with the conduct of their gas engine business considered it best to accept them and so save the heavy expenses of the defence. The settlement was therefore a satisfactory one to both parties, and one which cannot be legitimately considered by Mr. Otto as a victory.

If you will kindly publish this in your next issue I shall be much obliged.

Dugald Clerk.

166, Lozell's Road, Handsworth,
Birmingham 15th *July*, 1886.

[We have much pleasure in publishing Mr. Clerk's communication, which really corroborates our remarks. —EDS. ELEC. REV.]

Primary Batteries.

Enclosed I beg to hand you the copy of my report on the Regent battery, as promised. It will, of course, be remembered that the report was written for the information of capitalists who were thinking of taking up the patent. With reference to the Upward battery, I should not have again troubled you with any further remarks on this subject, but for the fact of your having published Dr. Oliver Lodge's report in your last issue.

I am surprised to find Dr. Lodge substantiating Mr. Upward's claim that there is no polarisation, and that no depolariser is used. If this means that no polarisation is *allowed* to take place, the statement is intelligible; but it certainly appears to me that the chlorine gas must act as a depolariser for the hydrogen gas, and that this is its most useful office; as it is evident that the mere chlorination of the zinc within the porous cell would be equally as well provided for by placing there a solution of chloride of zinc in the usual way.

It is stated by Mr. Crawley, in the columns of *Engineering*, on behalf of Mr. Upward, that no hydrogen gas is present in the carbon cell, and that no oxidation takes place in the zinc cell. As I presume that this statement is made upon Dr. Lodge's authority, I should be glad to know if he has tested the cell by chemical analysis, or upon what grounds he has formed his theory; and what, in his opinion, becomes of the oxygen and hydrogen gases which must undoubtedly be formed. So far as the practical working of the cell is concerned, provided it does certain work, it of course matters very little whether the sole action in the cell consists of the combination, decomposition, and recombination of zinc chloride; or, in addition, of an oxidation of the zinc, decomposition of water, and chlorination of the hydrogen; but if this new departure is to lead to something that will be of practical service at some future day, it is essential that we should know exactly what chemical combinations do take place within the cell.

Sydney F. Walker.

Cardiff, *July 20th*, 1886.

The Upward Battery.

With reference to Mr. Upward's letter in your last issue, I have only to answer the following:—

Before having adopted the use of a lead plate instead of a carbon one, I tried the disposition. The E.M.F. was the same as with a carbon plate, and resistance a little smaller, the lead giving better contact than carbon with broken carbon. The assertion of Mr. Upward is thus wrong as regards the first part of his reply to the use of lead. As regards the stoppage of the battery by the formation of lead chloride on the lead plate, I answer that the cell, at work for a week only, has always the same E.M.F. and resistance: the lead plate is coated with a thin layer of lead chloride, which disappears when the battery is at work.

I used equally without trouble asbestos cloth and parchment paper, which is somewhat cheaper; parchment paper is not burned by chlorine when in contact with water and salt. The renewal of porous pots, which is not confirmed by my own experience, could be quite avoided by using asbestos cloth.

As regards the addition of salt water, which seems so troublesome to Mr. Upward, it is not more difficult than adding pure water; and the cost of salt is compensated for by the small resistance of the cell.

Mr. Upward asserts that the disadvantages of high resistance, heavy prime cost, are avoided by the use of secondary batteries. I cannot admit this.

Mr. Oliver Lodge says, in his report on the Upward battery, that the "secondary battery is composed of about half the number of primary cells;" then each cell and accumulator having an E.M.F. of about two volts, there is about half the total number of "watts" produced, utilised in the lamp circuit!

As regards the formation of the double chloride of zinc and sodium, it has never been demonstrated in common salt batteries. I give in the description of my battery an explanation of the chemical action. Mr. Upward ends his letter by this enormity:

What is HO? Has Mr. Upward never seen the symbol of water in a chemical treatise based on the ideas of Dalton, Wollaston, Gay Lussac? OH!

J. W. Dierman.

University of Ghent, Belgium,
July 19th, 1886.

My friend, Mr. Upward, being too busy to write himself, asks me to say a few words in reply to Mr. Walker.

As that gentleman says, Mr. Upward very positively denied, without stating his reasons, the correctness of Mr. Walker's theory as to the action of the battery, and I should have thought that this would have been sufficient in itself to make Mr. Walker a little careful.

The E.M.F. has been given from the first as about 2·1 volts—that due to the direct action of Cl on Zn is 2·108. This is tolerably strong evidence in favour of the theory we hold. Of course we do not wish to be dogmatic about this or any other theory; all we say is that after much thought and experience it is the only one which we find will fit in with what occurs in practice as representing the action of the cell. For ourselves, we believe it to be the correct theory, but of course invite criticism from competent critics. The E.M.F. due to Mr. Walker's theory I leave him to work out, merely pointing out that having the E.M.F. of the cell distinctly given from the first, he has got between the horns of a most unpleasant dilemma—either he does not know how to find the E.M.F. which a cell working on his theory would give, or, knowing how, he has advanced and is fighting for a theory to which he has not applied this simple but crucial test. When he does apply it I think he will regret not having done so before he spoke.

The remainder of his letter is simply the expression of his opinion as opposed to other people's, and as such we are *quite* content to let it rest.

C. W. S. Crawley.

West Kensington.

P.S.—With regard to Dr. Lodge's report Mr. Walker will see that it appeared in your last issue at the same time as his letter.

C. W. S. C.

Electro-motors.

Your correspondent, "A Student," refers to some results of experiments given in a paper by me in the *Philosophical Magazine* for January last, which you were good enough to mention in your review of Mr. Kapp's book, and says that those experiments "merely verify a fact known long before they were made."

Whatever may have been known to "A Student," it is not difficult to show that the fact that a pure shunt motor if suitably constructed would, practically speaking, regulate perfectly, was not known to the foremost workers in the field,

The following facts, in chronological order, will sufficiently show the state of knowledge:—

1. May, 1883.—Ayrton and Perry read their well-known paper on "Electro-motors and their Govern-

ment," before the Society of Telegraph Engineers, in which they dealt at length with the question of speed regulation. There is not in that paper, as far as I am aware, a single sentence to show that they knew or supposed that a pure shunt motor was capable of practically perfect speed regulation; nor have they since that time published anything showing that they possessed such knowledge.

2. June, 1884.—The first edition of Prof. Silvanus Thompson's "Dynamo-electric Machinery" was published, in which the author, writing with full acquaintance with the state of knowledge on this subject, does not allude to the fact mentioned, as he certainly would have done had he been aware of it.

3. During the last few years many inventors and writers—Ayrton and Perry, Deprez, Silvanus Thompson, Frölich, Sprague, Fleeming Jenkin, Kapp, and others—have patented or have published descriptions of special devices for the purpose of obtaining constant or approximately constant speed, in ignorance of a simple means of attaining that end.

4. May, 1885.—In an article on motors in the *Engineer*, Mr. Kapp referred at length to the question of self-regulation of speed; stated that the problem was a difficult one if the source have a constant potential difference; and describes amongst other arrangements a plan of his own for solving the difficulty by using a separate generator for each motor, the generator having an E.M.F. varying to suit the requirements.

5. November, 1885.—In the second edition of Prof. Thompson's work some results of my own are published, showing that on a source of constant potential difference a simple shunt-wound "Victoria" motor had been made to run with a maximum variation of speed of 1·3 per cent., that is to say, practically with perfect self-regulation. Prof. Thompson refers to the fact as new, but says that it might have been foreseen from a certain formula. But it was not foreseen. The formula, so far as I know, was never used to express it, and evidently the full significance of the formula had not been realised by those who used it.

The recognition of this self-governing property of simple shunt motors by myself and my assistant, Mr. Watson, was not the result of the consideration of any mathematical expression—although I do not see that this affects the question—but was a result of practical consideration and experiment.

W. M. Mordey.

July 20th, 1886.

If "A Student" will carefully examine the account in your REVIEW, a few weeks back, of the experiment at Messrs. Mather and Platt's in which two Hopkinson-Edison machines were run, one as a dynamo, and the other as a motor, he will, I think, gain more information of the kind he desires than from any book that has been published. He should, also, read the subsequent correspondence between Dr. E. Hopkinson and Mr. Kapp. The nett result is that generators and motors must be constructed on precisely the same lines. Whatever construction makes a dynamo good as a generator will make it good as a motor.

George Hookham.

[There is not the least doubt that all modern dynamos, such as the Edison-Hopkinson, Crompton, Kapp, Phœnix, Victoria, and others, will give a very high *efficiency* when run as motors, but not one of those machines will be found suitable for the purposes to which electric motors are eminently applicable, viz., electric locomotion. Not merely the weight, but also the shape and size of a first-rate dynamo will be found inconvenient. Efficiency is only one of the virtues required of a machine. On the other hand, we know that a fairly good, but light, electro-motor will make a very inefficient dynamo, that is to say, a series machine giving say 70 per cent. efficiency as a motor will not yield 50 per cent. when run as a dynamo.—EDS. ELEC. REV.]

Critical Speed of Dynamos.

You have done me the honour in your editorial note, on page 53, to refer to a paper of mine in a contemporary of yours upon the "dead turns" of dynamos; but your remarks show that you have unwittingly credited me with more than is in any sense mine. They also give, quite unintentionally, I think, a personal turn to a purely impersonal question of scientific definitions. It is not I who have invented the term "dead turns"; that name was employed by that eminently practical engineer Dr. Frölich so far back as 1881. It is not I who have invented, or first used, or first misused (as you think), the term "critical speed," in its meaning (the one which I believe to be the most appropriate one, and the most generally accepted one) of the proper speed for self-regulation. That use was made of the term by others before me, and has been loyally accepted by me and used by me for the past four years. The term critical speed was used by me in my Cantor lectures, and in the first edition of my "Dynamo Electric Machinery," in this sense, throughout; and in the review with which you honoured me on September 14th, 1884, you had nothing to say against my use of the term. On page 292 (page 372 of second edition) I remarked that though there was a critical current for a series dynamo, there was not any such thing as a critical speed of the dynamo, *per se*, in the sense of least speed of self-excitation; and though the sentence was expressly printed in italics, no one of my reviewers at that date found anything to object to. Furthermore, on page 237 (page 301 of second edition) I defined the "critical speed" as "the particular speed of driving at which self-regulation holds good," and no exception was taken to the definition. At that time the confusion of thought between the two uses of the term had not arisen. For that confusion of thought I am in no way responsible. I was then, and have ever since been, consistent in using the term "critical speed" for this same thing. My impression was that it was the accepted term used by all electric engineers, both for self-regulating dynamos and for self-governed motors. The first hint that any confusion existed in the use of these terms came to me from an unsigned review in your esteemed contemporary the *Electrician*, about four months ago. When I ventured mildly to point out to the writer of that review that he misunderstood the sense in which the term was used throughout my book, and that he was using the term in a different sense, he introduced other issues in a correspondence which terminated by my requesting the editor of that periodical to decide as umpire what was the actual practice amongst accepted authorities on the subject of the dynamo. That is the only question that I raise now in addressing you. I do not care two straws whether I use one term or another, provided they are equally good. None of the terms are of my devising. I have no parental interest in any of them. But I have a real interest in getting a vexatious question of terms settled one way or the other; and I do care greatly that the confusion of thought involved in the ambiguous use of terms should be avoided.

The question, is, to which of the various speeds of the dynamo about which electricians require to speak is the term critical speed most applicable? There are four speeds that have to be mentioned:—

1. The least speed of self-excitation.
2. The speed at which self-regulation holds good.
3. The speed at which the armature overheats.
4. The speed at which the armature flies to pieces.

Each one of these four speeds is in a certain sense a critical speed; that is to say, it makes a difference whether the speed be less than or greater than a certain value. Your editorial note of this week hints that the word "critical" indicates instability. I may remark that there is a mathematical meaning of the term adopted into various branches of physics, notably into the science of heat, where we have a certain "critical point" at which the liquid and vapour states become

indistinguishable. The term means in general that a state of crisis, a turning-point, occurs. Which of the four crises that occur in the speed shall be called, par excellence, *the* critical point in the speed?

Your view, and that of another and less reasonable critic, is that of the four speeds, No. 1 should be called "the critical speed," and No. 2 "the regulating speed." My view (which I adopted simply because I believed it to be both the commonly-accepted one and the logically best one) is that No. 2 should be called the "critical speed," and I have always so called it. I have called No. 1 by the names of "the least speed of excitation," and the "dead turns." Dr. Frölich calls No. 1 the "dead turns," and he does not use the term "critical speed" for either, probably on account of the ambiguity attaching to it. Prof. Kittler, the highest German authority on electro-technical matters, calls No. 1 "dead turns," and No. 2 "critical speed" (kritische Tourenzahl), just as I have done. Some electricians call both No. 1 and No. 2 the critical speed; that is the confusion of thought and speech which I, equally with yourselves, am anxious to abolish. As you have pointed out in your issue of May 14th, 1886, No. 2 would be the same as No. 1 under certain impossible conditions. The least speed of excitation for a short-circuited series dynamo would be the same as the regulating speed for that same dynamo, not short-circuited, but wound with an additional shunt coil, provided iron could be found which was infinitely unsaturable! This impossible relation furnishes no excuse for confusion of thought or language.

I have stated my belief that in the common usage of electrical engineers the term "critical speed" is usually assigned to No. 2. You, on the contrary, say (page 53): "the meaning of critical speed is well understood by electricians, and only the Professor himself has given to the term a signification which had not been assigned to it previously." You are in error in thinking that "the Professor himself" has done anything of the kind. He has consistently, for some years, used the term "critical speed" for No. 2, and *not* for No. 1; was not the first to do so, nor is he the last to do so. He has no prejudice on the point, but down to the present time has only met—'tis, perhaps, his misfortune--with one ardent reviewer and one genial editorial trio who think him wrong. Your contention that it is not likely that practical men will substitute for the regulating speed the less apt (?) and more unscientific (?) definition "because of Prof. Thompson's likes and dislikes," is unfortunately beside the mark. For my experience is that practical men already call the regulating speed the critical speed; and I might equally fairly contend that we practical men are not likely to alter our present use of the term critical speed to something less apt, and to which no definite speed whatever can be assigned, because of the likes and dislikes of a trio of genial editors and of one anonymous critic. But, seriously, I am no less desirous than the Editors of the ELECTRICAL REVIEW to get this question settled, and I should be sorry if this letter did not do something toward settling the question. I would, in conclusion, once more restate the scientific reasons for calling No. 2, and not No. 1, the critical speed of the dynamo.

No. 1, *the least speed of excitation*, depends not only upon the design and construction of the machine and upon its resistances, but also on the resistance of the external circuit. There would be less objection to calling it "the critical speed of the machine and its external circuit together," but it is misleading to call it the critical speed *of the machine*. Every lamp switched in or out would alter the speed that would be critical. There would be as many different critical speeds as lamps!

No. 2, *the speed of self-regulation*, depends only upon the machine, and not on the resistance of its external circuit in anywise, or upon anything except the machine itself.

No. 3, *the speed of over-heating the armature*, depends, like No. 1, upon things external to the machine, and is higher the greater the external resistance.

No. 4, *the speed of rupture of the armature*, depends only on the mechanical build of the machine.

No one has proposed to call either of these two latter speeds the critical speed; and there is the same objection to No. 3 as to No. 1, namely, that it depends on things external to the machine itself.

So much for the scientific argument. There is also the good old conservative argument: whatever is is right. For more than three years I have used the term "critical speed" for No. 2; and I know many others who have done the same. This is no question of likes or dislikes. But we do not see why we should now depart from what we believe to be the usual and accepted terminology. No adequate reason has been given us as yet.

Silvanus P. Thompson.

[Notwithstanding the remarks of our correspondent, we are obliged to adhere to our former conviction that the speed of self-regulation has been termed "critical speed" simply through inadvertence in consequence of the impossible conditions to which Prof. Thompson refers having been at one time deemed possible. This impossible relation certainly furnishes no excuse for confusion, but here, nevertheless, we believe the origin of the confusion will be found. We of course take No. 1 as our definition of "critical speed," *i.e.*, the least speed of excitation, and, as we have already stated, we believe this to be the sense in which the term is understood by practical dynamo men. We shall be happy to ventilate the subject further in our columns, and we invite correspondence thereon.—EDS. ELEC. REV.]

A Menace to Electric Lighting.

It appears to me, whenever I venture to differ from you and to express my opinions in writing, that my pen is always running away from me, and blind enthusiasm causes me to rush into print without giving the subject I am writing about calm and mature consideration. Such, at all events, is the conclusion to be arrived at from the foot note which you append to my letter of the 13th inst., and from some notes which appeared in your journal a little while ago.

To refer, however, more particularly to the subject under discussion, you say that I introduce matters which are entirely irrelevant, and yet the first thing you do is to mix up matters telephonic in this discussion. I am quite prepared to stand by all that I have written in regard to Prof. Thompson and his Valve telephone, and I fail altogether to see why you should drag that in, as it has nothing whatever to do with the question at issue, viz., that Mr. Edison is the inventor of the incandescent lamp with the carbon filament, and that consequently his company has a right to a monopoly of the same. I am just as much in favour of "free trade in incandescent lamps" as you are; but not incandescent lamps with *carbon filaments enclosed in glass globes*. If I get a Werdermann lamp and stick it in a glass globe it is not an Edison lamp, for it has none of the characteristics which Edison claimed for his lamp. It has not a filament and it is not a lamp of high resistance. Yet they are both incandescent lamps, although they are as far removed from each other in point of construction as the sun is from the moon. I suppose you, sirs, contend that all Edison can claim is a bamboo fibre carbonised. Be that as it may, I still adhere to the opinion that Edison's lamp with the carbon filament was quite a new thing, and that it has been the means of making incandescent lighting successful. In conclusion, I would merely say in regard to your criticism on my own originality that—

> "There's nothing original in me
> Excepting original sin."

Charles Lever.

Colwyn Bay, N.W.,
July 19th, 1886.